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VASCULAR FLORA ADDITIONS AND NOTEWORTHY COLLECTIONS FROM QUETICO PROVINCIAL PARK, ONTARIO

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ABSTRACT

Quetico Provincial Park (QPP), in northwest Ontario between latitude N48.045 and 48.695 and longitude W90.850 and 92.275, protects more than half of a 2.2 million acre international wilderness of forest, water, and rock on the Canada/United States border. During a 16-day botanical study along the southeast edge of QPP, mostly over greenstone bedrock, 33 species new to QPP (including 2 new to northwest Ontario), as well as 55 others considered rare or scarce in the park, were found. Also encountered were 11 Ontario rare species (2 new to the park and all but 1 at new locations).

INTRODUCTION

Lying northwest of Lake Superior, with its southern edge abutting its United States (US) counterpart, the Boundary Waters Canoe Area Wilderness (BWCAW) in Minnesota, QPP is considered one of the finest canoeing areas in the world (Pauly 2005) (Figure 1). It is a rough chunk of 1,183,141 wilderness acres, approximately 55 miles east to west and 40 miles north to south, accessible by canoe and foot (only the northeast corner of the park can be reached by car). Boreal and Great Lakes pine forests (Heinselman 1996) cloak the ancient bedrock of the Laurentian Shield that is evident almost everywhere in the park, and thousands of pristine lakes and wetlands, created by an ill-defined drainage system, dot the landscape. Periodic wildfires have played an integral part in shaping the vegetation (Heinselman 1996) and man's influence has been minimal; much of the land has never been logged, and alien plants are absent from most of the park, gaining a foothold only at campsites and along portages.

A fine book, *Plants of Quetico and the Ontario Shield*, by Shan Walshe, on the complete vascular flora of QPP was published in 1980 and records 658 species. Because of the park's enormous size and remoteness, further exploration will undoubtedly discover additions to the flora, and it is my intention to produce, after more years of botanical exploration, a new book covering the flora of the two-nation Boundary Waters, the area protected by QPP and the BWCAW. Whereas most of QPP is underlain by granite, favoring plants tolerant of acidity, a small section of Quetico along the southeast border has a foundation of lime-rich greenstone, a metamorphosed Keewatin Period basalt, which favors development of calciphytes. It is this greenstone section that has produced almost all of my additions to the Quetico flora.

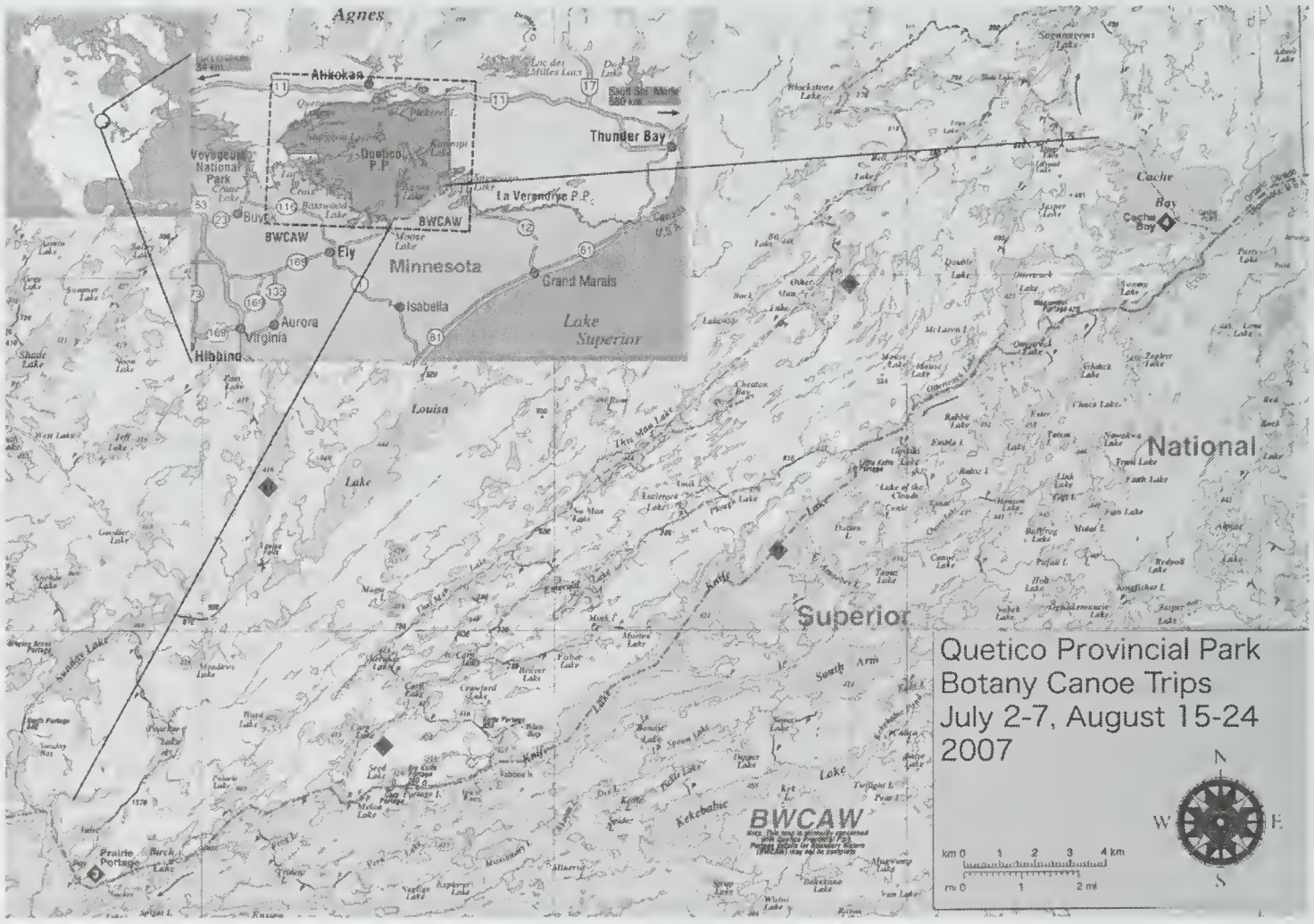

FIGURE 1. Map showing area of botanical survey in southeast section of Quetico Provincial Park. A dashed line indicates canoe route of the botanical survey. Two smaller inserted maps show QPP with surrounding land, and the park's position in North America. Adapted from "Quetico Provincial Park and Area" "Map section ©2009 Chrismar Mapping Services Inc. Used with permission under single-use licence. All Rights Reserved."

MATERIALS AND METHODS

Since it would require an enormous amount of time to adequately botanize the greenstone area of Quetico, I tried to focus my efforts on a variety of selected spots that I believed would give the most complete picture of the flora of the area. To this end, I tried to locate and do field work in specialized natural communities in the landscape to emphasize the diversity of plant species present. Necessarily, this entailed ignoring, to some degree, the general forest cover, which is already better known and less likely to lead to significant plant discoveries. By studying maps, aerial photographs, geological information, available plant literature (mainly Walshe 1980), and drawing on my own years of field work in the neighboring BWCAW, I selected areas to explore, and, once in the field, refined my search areas.

I collected plants that I recognized as being significant to the understanding of the flora, or that were unfamiliar to me. All collections are from QPP in Rainy River District, Ontario. For each plant gathered, notes were made on habitat and associate species, and, often, location was taken with a hand held Garmin eTrex GPS system. More than 200 collections (Scott #2730-2971) were sent to Michael Oldham at the Ontario Natural Heritage Information Centre (NHIC), for verification, and deposited in the Lakehead University herbarium (LKHD) in Thunder Bay, Ontario (a few collections were retained at the NHIC herbarium). There are three collections (2753, 2810, and 2961) cited in this report that I have misplaced, and thus are not in one of the herbaria.

Since QPP lies on the Ontario/Minnesota border and is within the same ecosystem protected by the adjoining BWCAW in Minnesota, distribution information for plants reported as "new" to the park is given for both province (Ontario) and state (Minnesota) to assess the significance of each species' presence in the park in relation to the undivided ecosystem and general region rather than by the limits imposed by national borders. Northern Ontario Plant Database (NOPD), a frequently cited plant distribution source in this paper, "is not comprehensive in its inclusion of northern Ontario

plant specimen data (e.g. large herbaria with significant holdings of northern Ontario plants such as TRT, DAO, and CAN have not yet been incorporated into the database)" (Michael Oldham, personal communication, 5 October 2008) and thus, should not be considered the definitive word on a plant's distribution, but only as an indicator of a plant's scarcity or abundance in northern Ontario.

NatureServe's "Srank" system (NatureServe 2008) for gauging rarity of plants within the province (Ontario) or state (Minnesota), with S1 = critically imperiled, usually 5 or fewer occurrences; S2 = imperiled, usually 6 to 20 occurrences; and S3 = vulnerable, usually 21 to 80 occurrences; is employed in this report.

RESULTS

Thirty-three species, one represented by two subspecies, plus one hybrid are here reported as new to QPP (Table 1). Two of these are new to northwest Ontario. Fifty-five species considered rare or scarce in the park were found (Table 2). Eleven Ontario rare species (Oldham 1999), two new to the park, and all but one at new locations, were also encountered. Of the new species found, all but four are native, and of the park rare species (Walshe 1980) discovered, all but six are native.

NOTES ON NEW PLANT RECORDS FOR QPP

Cystopteris laurentiana (Weath.) Blasd. (Dryopteridaceae) [Laurentian Bladder Fern] (Figure 2) originated as a cross between *Cystopteris fragilis* [Fragile Fern] and *C. bulbifera* [Bulblet Fern] (Haufler et al. 1993). It has the appearance of an oversized Fragile Fern with some glands on the rachis and is found on calcareous cliffs. Considered rare in much of its range, *C. laurentiana* is most common in the Driftless Area of the Midwest and about the northern Great Lakes (Haufler et al. 1993). In Ontario, where it is an S2S3 plant, it is found near the Minnesota border east of QPP, and along the north shores of Lakes Superior and Huron (Haufler et al. 1993; Cody & Britton 1989; NOPD 2008). In Minnesota, it occurs in river gorges by Lake Superior as well as on calcareous rocks in the southeast part of the state (MIN database 2008).

Scarce in thick moss on shaded SE facing cliff face near E end of Ottertrack Lake, with *Woodsia oregana,* 24 August 2007, Scott 2965.

This collection extends the fern's range northwest from Lake Superior (Haufler et al. 1993; Cody & Britton 1989; NOPD 2008).

Dryopteris expansa (C. Presl) Fraser-Jenkins & Jermy (Dryopteridaceae) [Spreading Wood Fern] has two separate ranges: one western, along the Pacific Coast and inland as far as the Canadian Rockies; and the other eastern, in a band across Canada from the Labrador Coast to a southwestern terminus near the west end of Lake Superior (Montgomery & Wagner 1993). In northwestern Ontario, it is confined almost exclusively to the area about Lake Superior, although there is one collection from 1957 by C.E. Garton in the "vicinity of French Lake Headquarters, QPP" that was not included by Walshe (1980) in his Quetico flora (NOPD 2008). Cody & Britton (1989) have mapped two collections in the QPP

TABLE 1. List of 33 plant species (1 represented by 2 subspecies) and 1 hybrid, all recorded for the first time in QPP. " (A)" identifies alien plants. Single digit numbers in parentheses correspond to the number of occurrences found on a given lake, and four digit numbers in parentheses correspond to specimen collection numbers.

Scientific name	Common name	Locations in Quetico Provincial Park
Cystopteris laurentiana	Laurentian Bladder Fern	Ottertrack Lake (2965)
Dryopteris expansa	Spreading Wood Fern	Emerald/Plough portage (2777)
Gymnocarpium jessoense	Nahanni Oak Fern	Blackstone, Emerald (4), Fisher, Littlerock, Other Man, Ottertrack (2), Sheridan, and This Man (2) Lakes (2742, 2752, 2770, 2773, 2780, 2802, 2827, 2879)
Woodsia alpina	Alpine Cliff Fern	Emerald Lake (2947, 2948)
Potamogeton foliosus	Leafy Pondweed	Emerald, Other Man, Plough, Poacher, This Man, and unnamed Lakes (2789, 2845, 2857, 2861, 2864, 2899)
Potamogeton friesii	Fries' Pondweed	Basswood Lake (2906)
Potamogeton illinoensis	Illinois Pondweed	Other Man and This Man Lakes (2859)
Potamogeton obtusifolius	Blunt-leaf Pondweed	Knife, Plough, and Other Man Lakes (2790, 2854, 2920, 2958)
Potamogeton strictifolius	Straight-leaf Pondweed	Basswood (2), No Man, Other Man, and This Man Lakes (2858, 2874, 2907, 2909)
Stuckenia filiformis subsp. *alpina*	Threadleaf Pondweed	Emerald Lake (2940)
Stuckenia filiformis subsp. *occidentalis*	Threadleaf Pondweed	Plough Lake (2959)
Calamagrostis stricta subsp. *inexpansa*	Marsh Reedgrass	Other Man Lake (2853)
Dichanthelium acuminatum subsp. *implicatum*	a Panic Grass	Beaver, Ottertrack, and Saganagons Lakes (2735, 2804, 2960)
Festuca rubra (A)	Red Fescue	Emerald and Other Man Lakes (2747, 2813)
Muhlenbergia glomerata	Marsh Muhly	Emerald, Other Man, and Sheridan Lakes (2851, 2855, 2882, 2884, 2955)
Muhlenbergia uniflora	One-flowered Muhly	Poacher Lake (2900)
Carex buxbaumii	Dark-scaled Sedge	Amik, Poacher, and This Man Lakes (2784, 2866, 2901)
Carex diandra	Bog Panicled Sedge	Amik, Carp, and Other Man Lakes (2756, 2783, 2805)
Carex eburnea	Ivory Sedge	Emerald Lake (2769, 2944)
Carex pseudocyperus	Cyperus-like Sedge	Emerald (2), Littlerock, This Man, and unnamed Lakes (2744, 2779, 2870, 2956)
Carex hystericina × *Carex pseudocyperus*	a hybrid sedge	Sheridan (2), This Man (2) and unnamed Lakes (2846, 2862, 2871, 2877, 2881)
Eleocharis elliptica	Elliptic Spikerush	No Man/That Man Lakes connecting stream (2762)
Eleocharis flavescens var. *olivacea*	Olive Spikerush	pond by Emerald Lake (2954)
Scirpus atrocinctus	Blackgirdle Bulrush	Emerald and Fisher Lakes (2797, 2801)
Silene cserei (A)	Balkan Catchfly	Carp Lake (2915)
Rubus superioris	Lake Superior Blackberry	pond north of Blackstone Lake (2740)
Hypericum canadense	Canada St. John's Wort	pond by Emerald Lake (2953)
Epilobium leptophyllum	Bog Willow-herb	Carp Lake (2932)
Oenothera oakesiana	Oake's Evening-primrose	Cache Bay and Emerald Lake (2731, 2809)
Myriophyllum alterniflorum	Alternate-flowered Water Milfoil	Knife, Saganagons, Sheridan, Slate, Sunday, and This Man Lakes (2843, 2873, 2883)

TABLE 1. Continued.

Scientific name	Common name	Locations in Quetico Provincial Park
Chamaesyce maculata (A)	Spotted Spurge	Ottertrack Lake (2971)
Hackelia deflexa	Northern Stickseed	Emerald and Ottertrack Lakes (2796, 2823)
Veronica arvensis (A)	Corn Speedwell	Other Man Lake (2748)
Galium tinctorium	Stiff Marsh Bedstraw	Cache Bay, Emerald and Saganagons Lakes (2733, 2834, 2951)
Artemisia campestris	Field Wormwood	Ottertrack Lake (2825)

area. In Minnesota, this fern occurs only in the counties directly north of Lake Superior (Ownbey & Morley 1991). It inhabits cool moist rocky woods often by streams, and swampy shaded alder thickets.

Locally common (100+ plants) in rich forest of large cedars along Emerald/Plough Lakes portage, with *Aralia racemosa, Athyrium angustum, Coptis groenlandica, Matteuccia struthiopteris, Mitella nuda,* and *Rubus parviflorus,* 5 July 2007, Scott 2777.

Gymnocarpium jessoense (Koidz.) Koidz. subsp. ***parvulum*** Sarvela (Dryopteridaceae) [Nahanni Oak Fern] (Figure 3) has a primary range that runs from Alaska across northwest Canada to a southeastern terminus near Lake Michigan.

FIGURE 2. Southeast facing cliff on Ottertrack Lake where *Cystopteris laurentiana* was discovered. Other plants found here include *Gymnocarpium jessoense* and *Woodsia oregana* on cliff; *Asplenium trichomanes, Arabis hirsuta,* and *Shepherdia canadensis* on talus; and *Muhlenbergia racemosa* on top of cliff; 11 August, 2008.

FIGURE 3. *Gymnocarpium jessoense* in protected nook of cliff, 30 July, 2008.

There are also a few isolated populations near the Atlantic Coast (Pryer 1993). In Ontario, where it is an S3 plant, most previous collections are in the Lake Superior and Lake Nipigon areas, but there are also sites near the Lake of the Woods and close to Hudson Bay (Cody & Britton 1989). In Minnesota it occurs only in the northeastern portion of the state (Ownbey & Morley 1991) with perhaps the greatest concentration of plants being on the cliffs of the Rove Formation at the northern edge of Cook County.

I believe all reports of *Gymnocarpium robertianum* (Walshe 1980) from QPP are actually *G. jessoense*, so this is a taxonomic reassignment rather than a new species in QPP. Walshe (1980) gives the status in the park as scarce, and lists three places: Emerald, Glacier, and Agnes Lakes.

A colony a few feet above waterline in moist cracks of overhung NW facing cliff on Blackstone Lake, 3 July 2007, Scott 2742; a colony within a few feet of waterline in moist cracks of NW facing overhung cliff on Other Man Lake, 4 July 2007, Scott 2752; scarce on NW facing cliff on Emerald Lake, 5 July 2007, Scott 2770; locally common under large cedars in fine soil of steep chute in NW facing cliff on Emerald Lake, 5 July 2007, Scott 2773; scarce on N facing cliff on Littlerock Lake, 5 July 2007, Scott 2780; a colony in cracks near waterline of small N facing overhung cliff on Fisher Lake, 6 July 2007, Scott 2802; scarce in fine soil of protected chute in ESE facing cliff on Ottertrack Lake, 7 July 2007, Scott 2827; hundreds of plants on ledges of NW facing cliff, Sheridan Lake, 18 August 2007, Scott 2879; a few small colonies in vertical crevices of NW facing overhung cliff on southern bay of Emerald Lake, 23 August 2007, Scott 2939; occasional on mossy cedar-shaded NW facing cliff face by Emerald Lake, 23 August 2007, Scott 2945; a colony in moss in vertical cracks of overhung SE facing cliff near E end of Ottertrack Lake, 24 August 2007, Scott 2967. Typical associates: *Aquilegia canadensis, Campanula rotundifolia, Cystopteris fragilis, Dryopteris fragrans, Huperzia lucidula, Polypodium virginianum,* and *Ribes oxyacanthoides.* Occasionally found with *Carex eburnea, Potentilla nivea, Woodsia alpina,* and *Woodsia glabella.*

Pryer (FNA 1993) says the fern's substrate is acid or neutral, but in the BWCAW (Rove Formation) and QPP (greenstone) the apparent substrate is calcareous, which is in line with the habitat given by Cody & Britton (1989). I believe the assessment of this species in QPP, "occasional throughout greenstone country" (Walshe 1980) is accurate. Nahanni Oak Fern may be confined to this southeast portion of the park where it occurs on and about cool moist cliffs, usually with a northern exposure (if not, then shaded), and often in moss. A favorite and specialized habitat where it can most predictably be discovered (often without competition from other vascular plants) is in crevices, within 10 or so feet of the water level, of overhung northwest-facing cliff faces that plunge directly into lakes.

Woodsia alpina (Bolton) Gray (Dryopteridaceae) [Alpine Cliff Fern] is a species that arose from hybridization between *Woodsia glabella* [Smooth Woodsia] and *W. ilvensis* [Rusty Cliff Fern] (Windham 1993). It generally grows on slaty or calcareous cliffs (Windham 1993) and has a northern distribution barely dipping into four northeastern states, S1 in each, and Minnesota, S3 [proposed

S2 (MDNR Draft 2007)], in the US, and even being rare in all but the far northern Canadian provinces and Alaska (NatureServe 2008). In Ontario, where it is an S2 plant, all previous locations, except for a couple in the far eastern part of the province, are from cliffs near Lake Superior or Lake Nipigon (NOPD 2008; Cody & Britton 1989). In Minnesota it occurs in only the two most northeastern counties where it is generally found on cliffs in river gorges by Lake Superior (MDNR Draft 2007). It also occurs in the BWCAW on cliffs by two lakes in the Rove Formation landscape of the far eastern part of the wilderness (MIN database 2008).

Scarce on mossy cedar-shaded NW facing cliff face by Emerald Lake, with *Aquilegia canadensis, Campanula rotundifolia, Cystopteris fragilis, Dryopteris fragrans, Gymnocarpium jessoense, Ribes oxyacanthoides, Woodsia glabella*, 23 August 2007, Scott 2947 & 2948. This cliff is very close to the Emerald Lake shore, but is hard to see from the lake because of cedars blocking the view.

This collection is the farthest west in Ontario (NOPD 2008, Cody & Britton 1989).

Potamogeton foliosus Rafinesque (Potamogetonaceae) [Leafy Pondweed] in QPP is close to the northern edge (Lake Nipigon area is the farthest north in Ontario) of its main range, although there are a few isolated populations much farther north in other provinces (Haynes & Hellquist 2000; NOPD 2008). It is distributed throughout the entire state of Minnesota (Ownbey & Morley 1991). In QPP it may have been overlooked because of its similarity to *Potamogeton pusillus*, from which it can be easily distinguished by the obvious undulate keels on the fruits (fruits of *P. pusillus* are keelless).

Plough Lake at portage to Amik Lake, 5 July 2007, Scott 2789; floating free in unnamed lake immediately N of Other Man Lake, 16 August 2007, Scott 2845; common in cove by island campsite, Other Man Lake, 16 August 2007, Scott 2857; common on muck bottom of easternmost finger of Cheaton Bay, This Man Lake, 17 August 2007, Scott 2861; occasional in bay of This Man Lake, 17 August 2007, Scott 2864; common in cove on N side of Poacher Lake, 20 August 2007, Scott 2899. Associates: *Bidens beckii, Myriophyllum farwellii, M. sibiricum, Najas flexilis, Nymphaea odorata, Potamogeton amplifolius, P. epihydrus, P. gramineus, P. illinoensis, P. natans, P. obtusifolius, P. richardsonii, P. robbinsii, P. strictifolius.*

Although *P. foliosus* appears to be relatively common in the alkaline waters of the greenstone area of QPP, it may turn out to be scarce or absent elsewhere in the park.

Potamogeton friesii Ruprecht (Potamogetonaceae) [Fries' Pondweed] has a general distribution in Minnesota, but has not been found in the two most northeastern counties (Ownbey & Morley 1991). According to Haynes & Hellquist (2000), the northern edge of its range barely reaches into northwest Ontario, although there appear to be several collections in the Northern Ontario Plant Database (NOPD 2008), notably one near the Hudson Bay, that are not mapped by Haynes & Hellquist (2000).

Sunday Bay, Basswood Lake, with *Najas flexilis, Potamogeton robbinsii, P. strictifolius, P. zosteriformis,* 21 August 2007, Scott 2906.

Potamogeton illinoensis Morong (Potamogetonaceae) [Illinois Pondweed] is found in the central part of Minnesota with only a few isolated populations in two northern counties (Welby Smith, personal communication, 19 Novermber 2008). Northwest Ontario appears to be north of the general range, although Haynes & Hellquist (2000) map a couple of isolated occurrences there. The NOPD (2008) lists no collections from the area.

This alkaline water pondweed is distinctive in that all leaves (wide with mucronate tips) tend to look alike, so that there is almost no difference in the underwater leaves and the floating (upper-most) leaves, if indeed this species can be said to have true floating leaves.

Common in cove by island campsite and elsewhere in Other Man Lake, with *Myriophyllum sibiricum, Najas flexilis, Nymphaea odorata, Potamogeton amplifolius, P. epihydrus, P. foliosus, P. richardsonii, P. robbinsii, P. strictifolius,* 16 August 2007, Scott 2859.

Illinois Pondweed was also found in This Man Lake on 17 August 2007, but was not collected there. This sighting and collection may represent the third isolated population of *P. illinoensis* in northwest Ontario (Haynes & Hellquist 2000).

Potamogeton obtusifolius Mertens & W.D.J. Koch (Potamogetonaceae) [Blunt-leaf Pondweed], in Minnesota, occurs primarily in the northern half of the state (Karen Myhre, aquatic botanist, personal communication, 24 November 2008). The NOPD (2008) shows three collections from northwest Ontario; two in the Lake Nipigon area and one (Wabigoon Lake) northwest of QPP. The habitat is moderately alkaline waters (Crow & Hellquist 2000).

Plough Lake at portage to Amik Lake, 5 July 2007, Scott 2790; occasional in flooded stream channel of southernmost arm of Other Man Lake, 16 August 2007, Scott 2854; locally common in shallow bay with muck bottom in Knife Lake, 22 August 2007, Scott 2920; occasional in Plough Lake, 24 August 2007, Scott 2958. Associates: *Bidens beckii, Myriophyllum farwellii, M. sibiricum, Najas flexilis, Nymphaea odorata, Potamogeton epihydrus, P. foliosus, P. robbinsii, P. zosteriformis, Sagittaria cristata, Stuckenia filiformis, Utricularia vulgaris.*

Potamogeton strictifolius Bennett (Potamogetonaceae) [Straight-leaf Pondweed] is another pondweed of alkaline waters (Crow & Hellquist 2000) and has a scattered and spotty distribution in Minnesota (Ownbey & Morley 1991). The northern edge of its range barely reaches northwestern Ontario (Haynes & Hellquist 2000) where it is known from two collections near Lake Superior and a collection northwest of QPP at Wabigoon Lake (NOPD 2008).

Common in cove by island campsite, Other Man Lake, 16 August 2007, Scott 2858; occasional in No Man Lake near stream entrance, 18 August 2007, Scott 2874; Sunday Bay, Basswood Lake, 21 August 2007, Scott 2907; common in shallow bay between Sunday Bay and Inlet Bay, Basswood Lake, 21 August 2007, Scott 2909. Associates: *Chara sp., Equisetum fluviatile, Myriophyllum*

sibiricum, Najas flexilis, Nymphaea odorata, Potamogeton amplifolius, P. epihydrus, P. foliosus, P. friesii, P. illinoensis, P. gramineus, P. natans, P. richardsonii, P. robbinsii, P. zosteriformis, Schoenoplectus acutus, Utricularia intermedia.

Stuckenia filiformis (Persoon) Borner subsp. ***alpina*** (Blytt) Haynes, Les, & Kral (Potamogetonaceae) [Threadleaf Pondweed] It is difficult to assess the distribution of this subspecies, because many collections are not designated to the subspecies level, but in Minnesota, there are no records from the two most northeastern counties (Ownbey & Morley 1991). In Ontario there is a collection from the Hudson Bay area specified to this subspecies and a few unspecified collections, all from farther east and mostly from the Lake Superior area (NOPD 2008). Like the other newly recorded pondweeds, it is found in calcareous waters.

300+ plants in 2–12 inches of water on bottom of wood chips over sand in NW cove of Emerald Lake, with *Hippuris vulgaris, Myriophyllum sibiricum?, Sparganium sp.,* 23 August 2007, Scott 2940.

Stuckenia filiformis (Persoon) Borner subsp. ***occidentalis*** (Robbins) Haynes, Les, & Kral (Potamogetonaceae) [Threadleaf Pondweed] is found sparingly in Minnesota. Karen Myhre (personal communication, 24 November 2008) has found the species several times in the north central part of the state. In Ontario it may be somewhat more widely distributed, again in calcareous waters. In both Ontario and Minnesota, there may still be confusion about the distribution, because according to Haynes & Hellquist (2000) "in the Great Lakes region, the name *Potamogeton [Stuckenia] vaginatus* has often been misapplied to this taxon. The distribution of *S. vaginatus* is further to the north and west than the Great Lakes region, however."

Occasional to common in Plough Lake, with *Potamogeton obtusifolius,* 24 August 2007, Scott 2959.

No fruit could be found, although there was an abundance of vegetative material. This taxon "rarely produces fruit in the eastern portion of its range, while to the north and west it commonly fruits" (Haynes & Hellquist 2000).

Calamagrostis stricta (Timm) Koeler subsp. ***inexpansa*** (Gray) Greene (Poaceae) [Marsh Reedgrass] is fairly widely distributed in northwest Ontario and is scattered through most of Minnesota (NHIC database 2008; Ownbey & Morley 1991). It has an affinity for alkaline substrates (Marr et al. 2007).

Common on edge of floating island in southernmost arm of Other Man Lake, with *Carex lasiocarpa,* 16 August 2007, Scott 2853.

Dichanthelium acuminatum (Sw.) Gould & Clark subsp. ***implicatum*** (Scribn.) Freckmann & Lelong (Poaceae) [a Panic Grass] has probably been reported from QPP under some other name. There still seems to be much taxonomic confusion in the *Dichathelium acuminatum* group. This plant grows in both wet and dry areas. I have observed this taxon to be fairly well distributed, but not abundant, in the BWCAW and likely so in QPP.

Scarce on large boulder on sandy beach at island campsite, Saganagons Lake, 2 July 2007, Scott 2735; common on wet shore rocks at E end of Beaver Lake,

6 July 2007, Scott 2804; occasional on S sloping bedrock by Ottertrack Lake, 24 August 2007, Scott 2960. Associates: *Juncus interior, J. tenuis, Rhus glabra, Selaginella rupestris, Solidago hispida.*

Festuca rubra L. (Poaceae) [Red Fescue] is an introduced polymorphic species that ranges widely in the northern hemisphere. There are scattered collections throughout Ontario and Minnesota (Darbyshire & Pavlick 2007; Ownbey & Morley 1991).

Common at campsite on small island in Other Man Lake, 4 July 2007, Scott 2747; occasional at island campsite on Emerald Lake, 7 July 2007 Scott 2813. Associates: *Agrostis gigantea, Capsella bursa-pastoris, Cerastium fontanum, Poa compressa, P. pratensis, Veronica arvensis.*

Muhlenbergia glomerata (Willd.) Trin. (Poaceae) [Marsh Muhly] is scattered throughout Minnesota (Ownbey & Morley 1991) and also appears to be found rather regularly in the southern part of northwest Ontario (Peterson 2003). There are records of this species from dry habitats that should probably be referred to *M. racemosa.*

In the BWCAW/QPP area, some characteristics typically used to separate *M. glomerata* from *M. racemosa* often lead to confusion. I believe the two species can be reliably separated, at least in this area, by habitat. *M. glomerata* occurs here only in very wet places, often on floating, non-acidic mats, whereas *M. racemosa* is found wholly on open, very dry, hot (south or west facing) bluffs, cliffs, and rock outcrops. Branching of the culms above the base is, I believe, a character found only in *M. racemosa.* Often the majority of plants in a given population of *M. racemosa* are unbranched, but there are almost always at least a few plants with multiple branching. This branching is not found in *M. glomerata.* One additional character that is consistent in separating my samples from the area (about 20 collections, mostly from the BWCAW in 2002, 2003, 2005, and 2006) is lemma hair pattern. In *M. racemosa,* on the back of the lemma, the area between the midvein and the lateral veins, is free of hairs, while the margins of the lemma and the callus (only on the side away from the back of the lemma) have long hairs. In *M. glomerata* long hairs are found over the entire surface of the lemma and the callus is hairy on all sides. A pronounced purple coloring in the inflorescence and culms seems to be a good indicator of *M. glomerata*, but while most of my *M. racemosa* samples have no purple in the inflorescence, a couple do have a hint of it. I have not found internode pubescence (almost all of my samples are pubescent), anther size, ligule size, or prominence of sheath midrib to be consistent in distinguishing the two species in the BWCAW/QPP area.

Several hundred plants at water's edge and in wetter spots of floating mat on both sides of stream/lake channel to southernmost arm of Other Man Lake, 16 August 2007, Scott 2851; a few plants by stream feeding southernmost arm of Other Man Lake, 16 August 2007, Scott 2855; a small population at water's edge of floating mat on S side of E running bay off of S arm of Sheridan Lake, 18 August 2007, Scott 2882; hundreds or thousands of plants on floating mat at S end of S arm of Sheridan Lake, 18 August 2007, Scott 2884; scarce at marshy pond

edge on NE side of Emerald Lake, 23 August 2007, Scott 2955. Associates: *Alnus rugosa, Campanula aparinoides, Carex lasiocarpa, C. cryptolepis, C. pseudocyperus, Chamaedaphne calyculata, Cicuta bulbifera, Drosera rotundifolia, Eriophorum angustifolium, E. russeolum, E. virginicum, Glyceria striata, Iris versicolor, Lycopus uniflorus, Malaxis unifolia, Menyanthes trifoliata, Myrica gale, Platanthera clavellata, Potentilla palustris, Rhynchospora alba, Sphagnum sp., Symphyotrichum boreale Thelypteris palustris, Triadenum fraseri, Vaccinium oxycoccus, Viola cucullata.*

Muhlenbergia uniflora (Muhl.) Fernald (Poaceae) [One-flowered Muhly] ranges from the North Atlantic Coast in a rather narrow band near the US/Canada border to a western terminus not far west of QPP (Peterson 2003). It inhabits "bogs, wet meadows, and lake shores in sandy or peaty, often acidic, soils" (Peterson 2003). There are about 15 collections from northwest Ontario (NOPD 2008). In Minnesota, where it is an S3 plant, it is found only in the 3 northeastern most counties (MIN database 2008). I have collected it in Lake County in the BWCAW about 10 times where it grows on moist sandy or gravelly lake shores, not too thickly vegetated, at a slightly higher (drier) elevation than its common associate there, *Rhynchospora fusca.*

M. uniflora has a very delicate appearance, unlike a typical *Muhlenbergia.* Voss (1972) notes that it is "unique in the development of buds just below the nodes" and often becomes "abundant following a lowering of water levels."

Several tufts found in 10′ × 10′ area of recently burned stream edge/wet meadow on N side of Poacher Lake, with *Calamagrostis canadensis, Carex buxbaumii, C. cryptolepis, Drosera rotundifolia, Myrica gale, Spiraea alba,* 20 August 2007, Scott 2900.

Carex buxbaumii Wahlenberg (Cyperaceae) [Dark-scaled Sedge] is scattered throughout Ontario and Minnesota in "wet meadows, marshes, and fens" (Murray 2002), but there are only two collections farther west than QPP in Ontario (NOPD 2008).

A colony in shallow water at campsite point on Amik Lake, 5 July 2007, Scott 2784; a few plants on gravel shore of This Man Lake, 17 August 2007, Scott 2866; scarce in recently burned stream edge/wet meadow on N side of Poacher Lake, 20 August 2007, Scott 2901. Associates: *Calamagrostis canadensis, Carex cryptolepis, Drosera rotundifolia, Juncus brevicaudatus, J. nodosus, Muhlenbergia uniflora, Myrica gale, Spiraea alba.*

Carex diandra Schrank (Cyperaceae) [Bog Panicled Sedge] grows in marshes (usually calcareous [Voss 1972]), fens, and on floating mats. It is found occasionally in Minnesota, and perhaps more commonly in Ontario (Ownbey & Morley 1991; NOPD 2008).

Scarce on talus rock at waterline in eastern-most bay of Other Man Lake, 4 July 2007, Scott 2756; common in shallow water marsh in Amik Lake at portage to Littlerock Lake, 5 July 2007, Scott 2783; on log in short stream from pond to Carp Lake (near portage to Emerald Lake), 6 July 2007, Scott 2805. Associates: *Asclepias incarnata, Carex aurea, C. bebbii, Iris versicolor, Liparis loeselii, Lycopus uniflorus, Mimulus ringens, Rumex orbiculatus, Typha latifolia.*

Carex eburnea Boott (Cyperaceae) [Ivory Sedge] is a rather wide-ranging sedge that favors well drained steep slopes with a neutral or calcareous substrate, although it does occasionally occur in other habitats. In northwest Ontario it has been found several times, but never as far west as QPP (NOPD 2008; NHIC database 2008). In Minnesota it is most frequently found in the southeast on bluffs bordering the Minnesota and Mississippi Rivers (Wheeler & Ownbey 1984), but there are now several collections from cliffs in the northeast part of the state (MIN database 2008).

Ivory Sedge has a delicate appearance and a distinctive corymbiform inflorescence arising from a small whitish spathe-like bract. Fruits can be held for more than a year (Wheeler & Ownbey 1984), making collections possible over a long period of the growing season.

Locally common in small mossy chute of NW facing cliff in Emerald Lake, 5 July 2007, Scott 2769; locally common in moss on NW facing cliff ledges near E end of Emerald Lake, 23 August 2007, Scott 2944. Associates: *Cystopteris fragilis, Saxifraga paniculata, Woodsia glabella.*

Carex pseudocyperus L. (Cyperaceae) [Cyperus-like Sedge] is scattered in the northern two-thirds of Minnesota, but poorly represented in the two most northeastern counties (Ownbey & Morley 1991). While its range appears to be centered on Ontario, where it is secure (NatureServe 2008), there are only about 10 previous collections from northwest Ontario (NOPD 2008).

Occasional on shore (collected at portage) of lake just N of Other Man Lake, 3 July 2007, Scott 2744; scarce on shore of Littlerock Lake at portage to Plough Lake, 5 July 2007, Scott 2779; scarce on cobble shore of This Man Lake, 17 August 2007, Scott 2870; scarce at marshy pond edge on NE side of Emerald Lake, 23 August 2007, Scott 2956. Associates: *Carex cryptolepis, Carex hystericina x pseudocyperus, C. intumescens, Carex stipata, Glyceria striata, Iris versicolor, Lycopus uniflorus, Muhlenbergia glomerata, Myrica gale, Potentilla palustris.*

All of my QPP collections are from calcareous, rocky lakeshores. I never found it in abundance.

Carex hystericina* × *Carex pseudocyperus (Cyperaceae) [a hybrid sedge] is considered the most common hybrid in the *Pseudocypereae* section of *Carex* (Reznicek & Ford 2002), but there are only four known collections from Ontario, three well east of Lake Superior, and Minnesota, one in the Twin Cities area (Anton Reznicek, personal communication, 9 December 2008). This sterile (achenes are undeveloped) plant is intermediate in characters between *C. hystericina* and *C. pseudocyperus*. It resembles *C. pseudocyperus* "except for (its) sterility, the slightly more inflated and less reflexed perigynia, and the substantial red tinging on the basal sheaths" (Reznicek & Ford 2002). The spikes are longer and slimmer than those of *C. hystericina* (much like *C. pseudocyperus*), but the perigynia are held at right angles to the axis rather than reflexed as in *C. pseudocyperus*. Late in the season (mid to late August), I was probably drawn to collect this hybrid more than its 2 fertile parents, because the perigynia remain in good shape longer than on plants that develop mature achenes.

Occasional plants in floating marsh at E end of S bay of unnamed lake im-

mediately N of Other Man Lake, 16 August 2007, Scott 2846; occasional plants on gravel/cobble mossy shore at narrows to Cheaton Bay, This Man Lake, 17 August 2007, Scott 2862; occasional plants on cobble shore of This Man Lake, 17 August 2007, Scott 2871; a few plants on cobble shore of Sheridan Lake, 18 August 2007, Scott 2877; a few plants in wet meadow NE of Sheridan Lake, 18 August 2007, Scott 2881. Associates: *Alnus rugosa, Calamagrostis canadensis, Campanula aparinoides, Carex cryptolepis, C. hystericina, C. lasiocarpa, C. pseudocyperus, Dryopteris cristata, Dulichium arundinaceum, Eupatorium maculatum, Gentiana rubricaulis, Impatiens capensis, Iris versicolor, Juncus nodosus, Lycopus uniflorus, Polygonum amphibium, Schoenoplectus tabernaemontani, Scirpus cyperinus, Thelypteris palustris, Triadenum fraseri.*

Eleocharis elliptica Kunth (Cyperaceae) [Elliptic Spikerush] has a fairly wide range and QPP seems to be in the heart of this range. The sole collection that is the basis of Shan Walshe's report of *Eleocharis intermedia* from Iron Lake in QPP (LKHD #061587) was annotated by Michael Oldham in 1995 as *E. elliptica* (Erika North, curator of LKHD, personal communication, 17 November 2008). There are about 30 other collections, all east of QPP, in northern Ontario (NOPD 2008). Most of the Minnesota collections come from counties near the Twin Cities area or in the northeastern part of the state (MIN database 2008). This spikerush is found on wet calcareous shores and in fens (Smith et al. 2002).

A good-sized colony in sandy-bottomed stream between No Man and That Man Lakes, with *Carex lasiocarpa, Equisetum fluviatile, Mimulus ringens, Osmunda regalis, Potamogeton epihydrus,* 4 July 2007, Scott 2762.

Eleocharis flavescens (Poiret) Urban var. ***olivacea*** (Torrey) Gleason (Cyperaceae) [Olive Spikerush] in Minnesota is at the northwestern limit of its range and is represented in the state, where it is an S2 species, by ten collections from the north central part of the state (Welby Smith, personal communication, 21 November 2008). In Ontario, the closest known collection comes from the east side of Lake Superior (M. Oldham, personal communication, 16 December 2008).

Thousands of plants in rich muck at water's edge (both in and out of water) of marshy pond, formerly flooded to greater depth by now-broken beaver dam, on NE side of Emerald Lake, with *Carex cryptolepis, Dulichium arundinaceum, Galium tinctorium, Hypericum canadense, Juncus brevicaudatus, Leersia oryzoides, Lycopus uniflorus, Nymphaea odorata, Polygonum amphibium, Potamogeton gramineus,* 23 August 2007, Scott 2954.

This collection is a range extender to the north. The habitat here, mucky (muddy) shore at water line, is similar to that of the other Minnesota collections (Smith 1988). This spikerush has a distinctive, yet easily overlooked, diaphanous leaf sheath encircling the lower part of the culm.

Scirpus atrocinctus Fernald (Cyperaceae) [Blackgirdle Bulrush] is a widely ranging species that probably was lumped together with *Scirpus cyperinus* by Walshe (1980). There are only 2 collections in the NOPD (2008), but Michael Oldham (personal communication, 5 October 2008) considers *S. atrocinctus* "much more common in northwestern Ontario than *S. cyperinus*, which has 84

records in the NOPD." There are collections in Minnesota from the northeastern two-thirds of the state (Ownbey & Morley 1991).

A few plants on shore of Emerald Lake at portage to Carp Lake, 6 July 2007, Scott 2797; occasional on shore of Fisher Lake, 6 July 2007, Scott 2801. Associates: *Carex interior, C. pseudocyperus, Juncus brevicaudatus, Mimulus ringens.*

Silene cserei Baumgarten (Caryophyllaceae) [Balkan Catchfly] is an introduced species that is now found in disturbed open habitats across the northern US and southern Canada. It is widely distributed in Minnesota (Ownbey & Morley 1991). In Ontario, the seven collections in the NOPD (2008) are all recent (past 15 years) and have been made by only one collector, Michael Oldham. I suspect this plant has been passed over because of similarities to another species, perhaps *S. vulgaris*, but it may simply be a recent immigrant to Ontario.

A few plants on steep S facing mostly open slope on campsite island in Carp Lake, with *Rhus glabra,* 22 August 2007, Scott 2915.

Rubus superioris Bailey (Rosaceae) [Lake Superior Blackberry] appears to be near the northwestern edge of its range in QPP (Smith 2008), although its status in Ontario may not be fully determined. In Minnesota there are scattered occurrences in the northern part of the state (Smith 2008).

Scarce on rocky shore at NE end of pond just NE of Blackstone Lake, with *Parthenocissus vitacea, Toxicodendron rydbergii,* 3 July 2007, Scott 2740.

Hypericum canadense L. (Hypericaceae) [Canada St. John's Wort] has a scattered distribution in eastern states and provinces. There are no previous collections from northwest Ontario (M. Oldham, personal communication, 19 November 2007) or the entire state of Minnesota (W. Smith, personal communication, 19 November 2008). The closest populations of *H. canadense* to QPP are in the upper peninsula of Michigan (Voss 1985). In Ontario the closest collections come from the eastern end of Lake Superior (M. Oldham, personal communication, 19 November 2007). Walshe (1980) actually included *H. canadense* in his flora of QPP, but this species is frequently confused with other *Hypericum* species, particularly small specimens of *H. majus*, and there are no known collections to confirm his report (M. Oldham, personal communication, 2008).

Hundreds or thousands of plants in rich muck (usually in places without heavy competition from other plants) of marshy pond, formerly flooded to greater depth by now-broken beaver dam, on NE side of Emerald Lake, with *Carex cryptolepis, Dulichium arundinaceum, Eleocharis flavescens* var. *olivacea, Galium tinctorium, Juncus brevicaudatus, Leersia oryzoides, Lycopus uniflorus, Nymphaea odorata, Polygonum amphibium, Potamogeton gramineus,* 23 August 2007, Scott 2953.

This collection represents a considerable northwest range extension (M. Oldham and W. Smith, personal communications).

Epilobium leptophyllum Raf. (Onagraceae) [Bog Willow-herb] is well distributed throughout Minnesota in open wetlands, but in northern Ontario collections are scarce, with the closest to QPP being found in the Lake of the Woods area (NOPD 2008).

Occasional in marsh/wet meadow at edge of Carp Lake by portage to Emerald Lake, with *Calamagrostis canadensis, Campanula aparinoides, Carex lasiocarpa, Cicuta bulbifera, Eupatorium maculatum, Gentiana rubricaulis, Lycopus uniflorus, Lysimachia terrestris, Symphyotrichum lanceolatum, Triadenum fraseri, Viola cucullata,* 22 August 2007, Scott 2932.

This willow-herb will probably be found in more QPP wetlands, as it is rather common in the BWCAW. I believe it has simply been overlooked in QPP.

Oenothera oakesiana (Gray) Robbins (Onagraceae) [Oake's Evening-primrose], in Minnesota, is found chiefly in the northeastern section of the state (Ownbey & Morley 1991). Ontario may be the only province in Canada where it is considered secure (also found in Newfoundland and Nova Scotia) (NatureServe 2008), although its status in northern Ontario is unclear because of nomenclature changes. Walshe (1980) doubtless included this species in the *O. biennis* complex.

Common on S facing rock bluff at beginning of narrows above Silver Falls, Cache Bay, Saganaga Lake, 2 July 2007, Scott 2731; occasional on small SE facing cliff in western most bay of Emerald Lake, 6 July 2007, Scott 2809. Associates: *Arabis hirsuta, Cystopteris fragilis, Heuchera richardsonii, Muhlenbergia racemosa, Pellaea glabella, Solidago hispida, Woodsia ilvensis.*

I believe this species will be found to be the most common Evening-primrose in QPP as *O. biennis* is probably confined to human-disturbed areas in the park. *Oenothera oakesiana,* although collected only twice, was commonly seen on cliffs throughout the greenstone area in 2007.

Myriophyllum alterniflorum DC. (Haloragaceae) [Alternate-flowered Water Milfoil] has a northern range and is found in Minnesota solely in the northeast part of the state (Ownbey & Morley 1991). The NOPD (2008) has no records of this species, but I doubt this is representative of its occurrence in northern Ontario.

Common in channel of Slate Lake leading toward Fran Lake, 15 August 2007, Scott 2843; occasional in This Man Lake at portage to No Man Lake, 18 August 2007, Scott 2873; common on bottom of deep muck throughout S arm of Sheridan Lake, 18 August 2007, Scott 2883. Associates: *Bidens beckii, Hippuris vulgaris, Myriophyllum farwellii, M. sibiricum, Najas flexilis, Nuphar variegata, Nymphaea odorata, Potamogeton gramineus, P. illinoensis, P. robbinsii, P. foliosus, P. strictifolius, Ranunculus aquatilis, Sagittaria cristata, Schoenoplectus subterminalis, Utricularia intermedia, U. vulgaris.*

It is surprising that this plant has not previously been reported from QPP. I have seen it quite often in lakes in the eastern BWCAW. It appears to be rather common in the greenstone area of QPP. In addition to the three lakes where it was collected, I observed it in Knife, Saganagons, and Sunday Lakes. It may prefer alkaline waters.

Chamaesyce maculata (L.) Small (Euphorbiaceae) [Spotted Spurge] is an introduced species that may be near the northern limit of its tolerance in QPP. The NOPD (2008) lists no collections from northern Ontario. In Minnesota it is

found predominantly in the southern two-thirds of the state (Ownbey & Morley 1991).

A few plants on gentle S sloping bedrock by shore at campsite near E end of Ottertrack Lake, with *Saxifraga virginiensis,* 24 August 2007, Scott 2971.

Perhaps Spotted Spurge requires a warm microclimate (open south facing rocks) to survive in this northern location. I have found it in the BWCAW area in hot gravel by roadsides and in parking areas.

Hackelia deflexa (Wahlenb.) Opiz (Boraginaceae) [Northern Stickseed] ranges across the entire continent, but is rare or absent in most eastern states and provinces (NatureServe 2008). In Minnesota it is scattered about the whole state (Ownbey & Morley 1991), but in northwest Ontario, the NOPD (2008) shows only four records, all east of QPP.

About a dozen plants seen near top of talus slope of S facing cliff on cove of Emerald Lake, 6 July 2007, Scott 2796; a few plants on S facing cliff ledge about 5 feet above waterline on Ottertrack Lake, 7 July 2007, Scott 2823. Associates: *Arabis divaricarpa, Chenopodium simplex, Cystopteris fragilis, Parthenocissus vitacea, Poa glauca, Ribes oxyacanthoides, Symphoricarpos albus, Viburnum rafinesquianum, Woodsia ilvensis.*

In the QPP/BWCAW area it is restricted to cliffs and talus slopes, although in other areas of its range, it occupies a greater variety of habitats. These two collections appear to be the westernmost in Ontario (NOPD 2008).

Veronica arvensis L. (Scrophulariaceae) [Corn Speedwell] is a widespread introduced weed, but has rarely been encountered in Minnesota and northwest Ontario. There are collections from five counties in Minnesota (MIN database 2008). In northern Ontario there is one collection from the Lake of the Woods area and one from the northeast side of Lake Superior (NOPD 2008).

Occasional at campsite on small island in Other Man Lake, with *Capsella bursa-pastoris, Cerastium fontanum, Festuca rubra, Poa pratensis,* 4 July 2007, Scott 2748.

Galium tinctorium (L.) Scop. (Rubiaceae) [Stiff Marsh Bedstraw] ranges over the entire eastern half of the US and into southeastern Canada. In northern Ontario there are about 15 collections, all east of QPP (NOPD 2008). In Minnesota it is found primarily in the eastern part of the state, but there are a few collections in the northwest (Ownbey & Morley 1991).

Scarce on gravel shore of island near campsite, Saganagons Lake, 2 July 2007, Scott 2733; occasional on gravel shore of channel to Silver Falls, Cache Bay, Saganaga Lake, 15 August 2007, Scott 2834; occasional in marshy pond, formerly flooded to greater depth by now-broken beaver dam, on NE side of Emerald Lake, 23 August 2007, Scott 2951. Associates: *Carex cryptolepis, C. utriculata, C. viridula, Deschampsia cespitosa, Dulichium arundinaceum, Eleocharis acicularis, E. flavescens* var. *olivacea, Epilobium ciliatum, Hypericum canadense, Juncus brevicaudatus, J. pelocarpus, Leersia oryzoides, Lycopus uniflorus, Lysimachia terrestris, Mentha arvensis, Nymphaea odorata, Polygonum amphibium, Potamogeton gramineus, Ranunculus flammula, Sium suave, Spiranthes romanzoffiana.*

TABLE 2. List of 55 seldom encountered QPP species. " Srank" for rare species is given in first column. Number of previous known locations in QPP is given in second column. "(A)" identifies alien plants. Single digit numbers in parentheses correspond to the number of occurrences found on a given lake, and four digit numbers in parentheses correspond to specimen collection numbers.

		Scientific name	Common name	New locations
	2	*Asplenium trichomanes* L.	Maidenhair Spleenwort	Ottertrack and This Man Lakes (2867, 2969)
S3	1	*Woodsia glabella* R. Br.	Smooth Cliff Fern	[relocation on Emerald Lake] and extension to nearby cliffy areas (2768, 2772, 2776, 2946, 2949)
S3	2	*Woodsia oregana* DC Eaton subsp. *cathcartiana* (Robinson) Windham	Oregon Cliff Fern	Littlerock, Other Man (2), Ottertrack (3), and This Man Lakes (2751, 2753, 2758, 2781, 2822, 2826, 2964)
	1	*Potamogeton praelongus* Wulfen	White-stem Pondweed	Emerald and Littlerock Lakes (2782, 2936)
	3	*Potamogeton robbinsii* Oakes	Fern Pondweed	Basswood, Emerald, Knife, Other Man, Swamp, and This Man Lakes (2745, 2829)
	2	*Potamogeton zosteriformis* Fernald	Flatstem Pondweed	Basswood, Carp, Crawford, Emerald, Knife, and Ottertrack Lakes (2908, 2916, 2919, 2935, 2963)
S3		*Sagittaria cristata* Engelmann	Crested Arrowhead	Knife, Ottertrack, Poacher, and Slate Lakes (2842, 2898, 2902)
	2	*Agrostis perennans* (Walter) Tuck.	Autumn Bent	Knife (Knife/Crawford) Portage (2917)
	2	*Alopecurus aequalis* Sobol.	Short-awn Foxtail	Basswood and Carp Lakes (2892, 2911)
S3	4	*Muhlenbergia racemosa* (Michx.) Britton	Green Muhly	Emerald (2), Ottertrack (2), and This Man Lakes (2794, 2810, 2868, 2961, 2970)
	3	*Leersia oryzoides* (L.) Sw.	Rice Cutgrass	Emerald Lake and Beaver/Carp portage (2952)
	2	*Carex aurea* Nutt.	Golden Sedge	Carp Lake (2806)
	1	*Carex bebbii* (Bailey) Olney	Bebb's Sedge	Amik, Beaver, Carp, Other Man, and Plough Lakes (2755, 2757, 2786, 2791, 2803, 2913)
	2	*Carex castanea* Wahl.	Chestnut Sedge	Emerald, Plough, and This Man Lakes, and Ottertrack/Plough portage (2760, 2818, 2820, 2937)
	1	*Carex hystericina* Muhl. ex Willd.	Porcupine Sedge	Emerald, Poacher, That Man, and unnamed Lakes (2765, 2812, 2875, 2896)
	1	*Eriophorum angustifolium* Honckeny	Narrow-leaf Cottongrass	Sheridan Lake (2886)
	1	*Eriophorum russeolum* Fries subsp. *leiocarpum* Novoselova	a Cottongrass	Other Man Lake (2850)
	1	*Eriophorum gracile* Koch	Slender Cottongrass	Emerald Lake (2938)
	2	*Lemna minor* L.	Lesser Duckweed	Knife Lake (2923)
	3	*Spirodela polyrhiza* (L.) Schleiden	Common Water-flaxseed	Knife Lake (2924)
S3	2	*Juncus interior* Wieg.	Inland Rush	Saganagons Lake (2734)
	2	*Liparis loeselii* Rich.	Loesel's Twayblade	Other Man Lake (2754)
	3	*Malaxis unifolia* Michx.	Green Adder's-mouth	Other Man and Sheridan Lakes (2849, 2885)
		Platanthera clavellata Michx.	Clubspur Orchid	Blackstone Creek and Other Man Lake (2852)

	3	*Spiranthes romanzoffiana* Cham.	Hooded Ladies' Tresses	Cache Bay, Saganaga Lake (2836)
	1	*Parietaria pensylvanica* Muhl. ex Willd.	Pennsylvania Pellitory	Ottertrack Lake (2) (2821)
S3		*Quercus ellipsoidalis* E.J. Hill	Hill's Oak	Birch Lake at Prairie Portage (2897)
	2	*Polygonum punctatum* (Elliot) Small	Dotted Smartweed	Carp and Knife Lakes (2800, 2925)
	1	*Rumex triangulivalvis* (Danser) Rech. f.	Willow-leaf Dock	Basswood Lake (2891)
	1	*Chenopodium album* L. (A)	Lamb's Quarters	Saganagons Lake (2736)
	1	*Anemone virginiana* L. var. *cylindroidea* Boivin	Virginia Anemone	Birch/Carp portage and [relocation on Big Knife Portage] (2889, 2929)
		Ranunculus aquatilis L. var. *diffusus* Withering	White Water Crowfoot	Saganagons and Slate Lakes (2839, 2841)
	1	*Arabis hirsuta* (L.) Scop.	Hairy Rockcress	Cache Bay, Emerald (2), Other Man, Ottertrack (2), and This Man Lakes, and [relocation on Plough Lake] (2730, 2750, 2817, 2869, 2934, 2941, 2968)
	1	*Capsella bursa-pastoris* (L.) Medicus (A)	Shepherd's Purse	Other Man Lake (2749)
S3		*Subularia aquatica* L.	Awlwort	Saganagons Lake (2840)
	1	*Saxifraga paniculata* P. Mill.	Encrusted Saxifrage	[relocation on Emerald Lake] and extension to nearby cliffs (2771)
	1	*Ribes lacustre* (Pers.) Poir.	Bristly Black Currant	Amik, Bell, and Emerald Lakes (2787, 2816)
	2	*Potentilla argentea* L. (A)	Silvery Cinquefoil	Big Knife Portage (2928)
S2	1	*Potentilla nivea* L.	Snowy Cinquefoil	[relocation on Emerald Lake] (2775)
	2	*Celastrus scandens* L.	Climbing Bittersweet	Blackstone, Ottertrack, and This Man Lakes (2741)
	3	*Tilia americana* L.	American Basswood	Birch Lake (2910)
		Shepherdia canadensis (L.) Nutt.	Buffalo Berry	Cache Bay, Carp, Ottertrack, and Sheridan Lakes (2833, 2878, 2912, 2966)
	1	*Osmorhiza depauperata* Phil.	Blunt-fruit Sweet Cicely	[relocation on Emerald/Plough portage] (2778)
	2	*Gentiana rubricaulis* Schwein.	Redstem Gentian	Carp, Poacher, and Sheridan Lakes, and [relocation on Plough Lake] (2819, 2880)
	4	*Apocynum sibiricum* Jacq.	Indian Hemp	Saganagons Lake (2737)
	4	*Asclepias incarnata* L.	Swamp Milkweed	Amik (3) and Other Man Lakes (2785, 2856)
	5	*Cynoglossum boreale* Fernald	Northern Hound's-tongue	This Man/No Man and Carp/Beaver portages (2761)
	1	*Clinopodium vulgare* L.	Wild Basil	Monument Portage and [relocation on Saganaga/Swamp portage] (2828)
	1	*Scrophularia lanceolata* Pursh	Hare Figwort	Big Knife Portage (2930)
	1	*Veronica serpyllifolia* L. (A)	Thyme-leaf Speedwell	Basswood/Poacher portage and Other Man Lake (2894)
	4	*Utricularia minor* L.	Lesser Bladderwort	Knife Lake (2927)
	2	*Bidens frondosa* L.	Devil's Beggar-ticks	Knife Lake and [relocation at Prairie Portage] (2918)
	2	*Cirsium vulgare* (Savi) Tenore (A)	Bull Thistle	Carp Lake and Prairie Portage (2887)
	4	*Petasites sagittatus* (Banks ex Pursh) Gray	Arrowleaf Coltsfoot	[relocation on Emerald Lake] (2793)
	2	*Symphyotrichum boreale* (T. & G.) A. Love & D. Love	Rush Aster	Other Man and Sheridan Lakes (2848)

Artemisia campestris L. (Asteraceae) [Field Wormwood] is scattered throughout Minnesota (Ownbey & Morley 1991) and Ontario, but is seemingly scarce in the QPP/BWCAW area. In northwest Ontario there are now numerous sight records from sandy/rocky shores and cliffs (NHIC database 2008).

Scattered about on ESE facing cliff ledges on Ottertrack Lake (found occasionally on cliff ledges in 500 linear meter area), with *Campanula rotundifolia, Fragaria vesca, Heuchera richardsonii, Pellaea glabella, Ribes oxyacanthoides, Selaginella rupestris, Viola adunca, Woodsia ilvensis,* 7 July 2007, Scott 2825.

In the QPP/BWCAW area, the only two populations of which I am aware grow on calcareous cliffs.

NOTES ON SELECTED SELDOM ENCOUNTERED QPP SPECIES

Asplenium trichomanes L. (Aspleniaceae) [Maidenhair Spleenwort] {S2 in Minnesota}—In the QPP/BWCAW area, at the northwest limit of its eastern North American range (Wagner et al. 1993), *A. trichomanes* grows on talus and cliffs with an eastern exposure. Most plants grow among talus rocks near the top of talus slopes where there is some shade provided by *Parthenocissus vitacea* (seemingly a constant associate) and other woody vines, shrubs, and trees, but there are generally a few plants found in nooks and crannies of the cliff face as well.

It is curious to note that BWCAW collections have been assigned by Moran to the subsp. *trichomanes* (Smith 1988) that occurs on "acidic rocks such as sandstone, basalt, and granite, very rarely on calcareous rocks" (Wagner et al. 1993) although the Rove Formation cliffs on which these populations are found are calcareous. One would assume from the range maps given (Wagner et al. 1993) that the QPP populations are also subsp. *trichomanes*, yet here too, the substrate, lime-rich greenstone, is calcareous.

Woodsia glabella R. Br. (Dryopteridaceae) [Smooth Cliff Fern] {S3 in Ontario, S2 in Minnesota}—Two unique stipe characters, greenness and glabrousness, set this delicate fern apart from all other *Woodsia* species.

My collections are from the only previously known QPP site (Scott 2776) and expand the population to cliffs both east (Scott 2946 & 2949) and west (Scott 2768 & 2772). This may be the most western location in Ontario (NOPD 2008). All of these sites are cool, moist (some heavily shaded), north or northwest-facing calcareous cliffs. Collection #2949 is a particularly husky sample with fronds abnormally wide and pinnae more lobed than is characteristic of this species.

There is also a lone site in the BWCAW for this fern, on a mossy shaded wet east-facing Rove Formation cliff (Scott 704). The QPP/BWCAW sites are at the southern edge of the range of *W. glabella* (Windham 1993). The only other stations for this fern in Minnesota are close to Lake Superior (Ownbey & Morley 1991).

Woodsia oregana DC Eaton subsp. ***cathcartiana*** (Robinson) Windham (Dryopteridaceae) [Oregon Cliff Fern] {S3 in Ontario, proposed S3 in Minnesota

(MDNR Draft 2007)}—QPP is near the northern edge of this fern's range (Windham 1993). The plants grow in crevices of usually exposed (one shaded) southeast (one east southeast) to south-facing calcareous cliffs.

Potamogeton robbinsii Oakes (Potamogetonaceae) [Fern Pondweed] –I believe this pondweed is common or abundant in the greenstone lakes of QPP where it occurs in characteristic large dense colonies (Haynes & Hellquist 2000).

Sagittaria cristata Engelmann (Alismataceae) [Crested Arrowhead] {S3 in Ontario}—This is a Midwestern species of alkaline waters with the northern edge of its limited range being in the vicinity of QPP. Although, as Walshe (1980) noted, it is not rare in the park, QPP may supply the bulk of the population in Ontario. In fact, the only collection in the NOPD is one by Walshe from Mack Creek in the southeast part of QPP. In addition to my three collections, I noted this arrowhead in Knife (bay west of Back Bay) and Ottertrack (bay at Monument Portage) Lakes.

Haynes & Hellquist (2000) give the habitat as "sandy margins and bottoms of lakes, ponds, and swamps." In the QPP/BWCAW area I find it almost always in shallow muck-bottomed bays, although one of my QPP collections was in clean very fine, somewhat gooey sand.

Muhlenbergia racemosa (Michx.) Britton (Poaceae) [Green Muhly] {S3 in Ontario}—Although this species is presently S3 in Ontario, it has recently been collected multiple times in northwest Ontario and may be moved soon to S4 (M. Oldham, personal communication, 2007). It is primarily a plant of the Great Plains where it grows in a variety of habitats. Prior to 2002, *M. racemosa* was unknown in the BWCAW, but I have found it there more than ten times since then, mostly over greenstone. In the QPP/BWCAW area its habitat is very hot dry bluffs, cliffs, and rock outcrops. In the Boundary Waters region, *M. racemosa* and *M. glomerata* have often been confused with each other. See *M. glomerata* for distinctions between these two *Muhlenbergia* species.

Carex bebbii (Bailey) Olney (Cyperaceae) [Bebb's Sedge]—I believe this sedge will be found to be relatively common on the rocky/gravelly lakeshores in the greenstone area of QPP. However, since it requires a calcareous or neutral substrate (Mastrogiuseppe et al. 2002), it may be absent from much of the park. Until one examines the perigynia, it is easily mistaken for *Carex crawfordii*, a very common lakeshore sedge in this region.

Eriophorum russeolum Fries subsp. ***leiocarpum*** Novoselova (Cyperaceae) [a Cottongrass]—In Ontario there are very few collections and most of these are in the Hudson Bay area (NOPD 2008). This species in the Great Lakes region was previously known as *E. chamissonis* C.A. Meyer ex Ledeb., a species now understood to occur only much farther west (Cayouette 2004).

Eriophorum gracile Koch (Cyperaceae) [Slender Cottongrass]—Ball & Wujek (2002) state this Cottongrass grows usually on acidic substrates, but I believe at Emerald Lake, the substrate must be calcareous.

Spirodela polyrhiza (L.) Schleiden (Lemnaceae) [Common Water-

FIGURE 4. *Spiranthes romanzoffiana* and *Juncus interior* on shore of Saganaga Lake, 10 August, 2001.

flaxseed]—QPP is near the northern edge of this species range (Landolt 2000). The NOPD (2008) has no collection records.

Juncus interior Wieg. (Juncaceae) [Inland Rush]{S3 in Ontario} (Figure 4)—Inland Rush is near the northern edge of its range in QPP (Brooks & Clemants 2000). M. Oldham and W. Bakowsky have added a rash of reports of this species in the last ten years from northwest Ontario (NHIC database 2008). It looks much like the common Pathway Rush (*J. tenuis*), which is often found in the same bedrock shore crevice habitat.

Liparis loeselii (L.) Rich. (Orchidaceae) [Loesel's Twayblade]—In the BWCAW/ QPP area I have found this orchid at the water's edge of floating sphagnum mats and in bare (seemingly dry) sand. Smith (1993) reports that it "tolerates a range of pH values from weakly acidic to strongly calcareous."

Whiting & Catling (1986) describe a wide range of wet to drier habitats including old gravel pits, where I have also found it.

Malaxis unifolia Michx. (Orchidaceae) [Green Adder's-mouth]—In the QPP/BWCAW area, I have found this orchid in a wide range of habitats including rock glades, shrub thickets, and floating mats.

Platanthera clavellata (Michx.) Luer (Orchidaceae) [Clubspur Orchid] {S3 in Minnesota}—In addition to my collection, I saw this orchid on a floating mat by Blackstone Creek. The QPP/BWCAW area is near the northwest edge of this orchid's range (Sheviak 2002), but I believe it is more common here than originally thought. I have encountered it in the BWCAW ten times in last five years, most often on floating mats, but also in a sparsely-treed bog forest and a streamside wetland.

Spiranthes romanzoffiana Cham. (Orchidaceae) [Hooded Ladies' Tresses] (Figure 4)—Whiting & Catling (1986) observed *S. romanzoffiana* "in a variety of habitats, but always in moist and more or less open situations." Smith (1993) states that *S. romanzoffiana* inhabits "fens, meadows, and open conifer swamps" and less often lakeshores, but in the QPP/BWCAW area it may be that the lakeshore habitat is more common. I have found it on both sides of the international boundary on sandy and gravelly lakeshores.

Parietaria pensylvanica Muhl. ex Willd. (Urticaceae) [Pennsylvania Pellitory]—*P. pensylvanica* is a somewhat weedy annual found farther south in rather dry woods and woods' edges as well as cliffy areas. Boufford (1997) does not include the QPP/BWCAW area in its range whose northern edge is mapped about 200 miles south of the BWCAW.

In addition to my collection, I saw *P. pensylvanica* on another Ottertrack Lake cliff farther east and have collected it twice in the BWCAW; just south of Ottertrack Lake on a greenstone cliff on Ester Lake, and farther east on a cliff (Rove Formation) on Daniels Lake. These QPP/BWCAW collections, along with six collections by Oldham and Bakowsky from northwestern Ontario (NOPD 2008), would appear to constitute a northern disjunct population of Pennsylvania Pellitory (Boufford 1997). All of these collections share the warm dry calcareous cliff/rock outcrop habitat favored at this northern latitude.

Quercus ellipsoidalis E.J. Hill (Fagaceae) [Hill's Oak] {S3 in Ontario}—Walshe (1980) writes "common only on knolls of bare bedrock on the International Boundary Lakes: La Croix, Iron, Crooked, Basswood." Apparently the northern edge of the range of *Q. ellipsoidalis* barely crosses into Canada along the Minnesota border, with QPP being at the northeastern corner of its distribution. All other northern Ontario collections of Hill's Oak, mostly by Oldham and Bakowsky, are west of QPP in a narrow strip near the Minnesota border (NOPD 2008).

Anemone virginiana L. var. ***cylindroidea*** Boivin (Ranunculaceae) [Virginia Anemone]—The NOPD (2008) lists two collections, both by Oldham and Bakowsky, in northwest Ontario. Its is difficult to tell what the natural habitat for

Virginia Anemone is in the region or if it is really part of the established flora, because the collections are associated with man-made disturbance (roadside, railroad side, and, in the case of my two collections from QPP, heavily used portages).

Ranunculus aquatilis L. var. ***diffusus*** Withering (Ranunculaceae) [White Water Crowfoot]—There is not complete agreement on the taxonomic treatment of this plant. I have followed the treatment in "Flora of North America" (Whittenmore 1997) which combines Walshe's two White Water Buttercups species, *R. aquatilis* L. and *R. longirostris* Gordon, into one.

Chenopodium album L. (Chenopodiaceae) [Lamb's Quarters]—Clemants & Mosyakin (2003) wrote: "*C. album*, one of the worst weeds and most widespread synanthropic plants on the Earth, in its broad circumscription is also among the most polymorphic plant species. It is a loosely arranged aggregate of still insufficiently understood races." It would seem a testament to the fine quality of the wilderness of QPP that this weed has been reported only once previously from a developed area at French Lake.

Rumex triangulivalvis (Danser) Rech. f. (Polygonaceae) [Willow-leaf Dock]—This is a wide spread rather weedy plant growing in "many types of ruderal and alluvial habitats" (Mosyakin 2005). My Quetico collection is from a heavily visited lakeshore, and my only other QPP/BWCAW area collection is from a roadside.

Polygonum punctatum (Elliott) Small (Polygonaceae) [Dotted Smartweed]—The NOPD (2008) has no collection records for this species.

Arabis hirsuta (L.) Scop. (Brassicaceae) [Hairy Rockcress]—In the QPP/BWCAW area *A. hirsuta* grows exclusively on calcareous cliffs, but elsewhere in its range it also occurs in such diverse habitats as moist shores, hillsides, woods, and grass areas (Voss 1985).

Subularia aquatica L. (Brassicaceae) [Awlwort] {S2 in Minnesota, S3 in Ontario}—This species seems to be rare throughout most of its range. Smith (1988) noted: "In fact, the entire range of *Subularia aquatica* seems to comprise a series of isolated outposts." In Minnesota it is known from a handful of sites in the northern part of the three counties above Lake Superior (Smith 1988) and in northwest Ontario it is known from a few scattered stations (unpublished map at NHIC). Walshe (1980) writes "scarce but not rare, locally very abundant ... at several stations in Quetico: French, Pickerel, Saganaga, Crooked Lakes." There are only two known Walshe collections (QPP herbarium), but he obviously knew it from more sites in QPP.

Awlwort is a very small annual found in the QPP/BWCAW area on sand or fine gravel bottoms in shallow water where it sometimes grows in dense colonies. It appears to both flower and fruit under water, as well as above water, if it becomes stranded. In addition to my Saganagons sample, I have collected it in the BWCAW area in Koma, Horseshoe, East Bearskin, Northern Lights, and Cherokee Lakes and believe that it will turn out to be more plentiful in the Boundary Waters than was previously thought.

Saxifraga paniculata P. Mill. (Saxifragaceae) [Encrusted Saxifrage] {S2 in Minnesota}—Encrusted Saxifrage is a charming little plant that festoons cliffs with its mounded leaf rosettes. Each leaf, with its fine saw teeth highlighted by white lime encrustations, resembles a miniature chain saw blade. In Minnesota this saxifrage was previously thought to be confined to north and northwest facing cliffs of the Rove Formation, as well as a single isolated site on Gordon Lake, in the BWCAW area. However, recent discoveries of populations along Lake Superior (some east-facing), as well as more sites in the Rove Formation, have prompted a move to change the plant's status to S3 (MDNR Draft 2007). There have also been many recent discoveries, all east of QPP, in Ontario (NHIC database 2008). With the exception of a couple from the Rove Formation along the Minnesota border, almost all have been from the Lake Superior or Lake Nipigon areas. Together, the Minnesota and Ontario sites make up a southwest disjunction from the main range hundreds of miles to the north and east (Smith 1988).

My collection comes from a cliff to the west of the only previously known QPP occurrence. I also found it with *Carex eburnea* on mossy cliff ledges to the east of the known site, thus expanding the old site in two directions. The Emerald Lake population appears to be the northwestern extreme of the Lake Superior disjunction of *S. paniculata*.

Ribes lacustre (Pers.) Poir. (Grossulariaceae) [Bristly Black Currant]—This currant is "usually easily recognized by the densely spiny glossy light brown young twigs" (Voss 1985). It is well distributed in Ontario, except that collections north of the Minnesota border are lacking (Soper & Heimburger 1982).

In addition to my 2 collections, this currant was also noted in the cedar forest at the south end of Bell Lake. In the QPP/BWCAW area its habitat is very rich moist coniferous (usually cedar) forests and swamps.

Potentilla argentea L. (Rosaceae) [Silvery Cinquefoil]—Silvery Cinquefoil is a common introduced weed of open dry sandy soils (Voss 1985). In the BWCAW area, I have found this weed a few times on rock outcrops frequented by people, on gravelly paths, and in gravel pits.

Potentilla nivea L. (Rosaceae) [Snowy Cinquefoil]{S2 in Ontario, absent in Minnesota} (Figure 5)—The four collections in the NOPD (2008) are all from the Hudson Bay area. My collection is a relocation of the park's only confirmed record of this arctic species. All plants, a total of at least 35 clumps, are rooted on ledges and in cracks within 15 feet of the water level of the partially overhung north facing cliff pictured on page 62 of Walshe's *Plants of Quetico and the Ontario Shield* (1980). Most were in fruit on July 5, but a couple still had late flowers. Scoggan (1978) gives the habitat as "dry calcareous rocks and slopes." The Emerald Lake site appears to be a small remnant population greatly disjunct from the main range, whose southern edge skirts the Hudson Bay.

Celastrus scandens L. (Celastraceae) [Climbing Bittersweet]—In the BWCAW I have found this twining vine a few times in its favorite habitat on

FIGURE 5. *Potentilla nivea* on north facing cliff, Emerald Lake, 5 July, 2007.

warm talus slopes where it typically associates with *Parthenocissus vitacea* (Virginia Creeper) and *Toxicodendron rydbergii* (Poison Ivy). This is also the habitat of a sighting I made on This Man Lake, August 17, 2007, (no collection taken). The wooded habitat of the collection from the cedar forest north of Blackstone Lake was surprising. The QPP/BWCAW area is at the northern edge of Climbing Bittersweet's range (Soper & Heimberger 1982).

Shepherdia canadensis (L.) Nutt. (Elaeagnaceae) [Buffalo Berry] {proposed S3 in Minnesota (MDNR Draft 2007)}—Buffalo Berry is immediately recognized by its distinctive leaves "densely scurfy-pubescent beneath with mixed silvery and rusty brown scales and hairs" (Voss 1985). Janice Matichuk, Quetico

Park Ranger stationed in Cache Bay, showed me the location of collection #2833 and said she knew of many sites around Cache Bay for this bush. Buffalo Berry's affinity for calcareous soils is shown by its distribution in the QPP/BWCAW area where it is usually found on somewhat open south-facing slopes. In addition to my Quetico greenstone collections, I have found Buffalo Berry in the BWCAW area three times over greenstone and twice in the Rove Formation soils. At most of the sites I found only one or two bushes, but a couple of locations had close to ten.

Osmorhiza depauperata Phil. (Apiaceae) [Blunt-fruit Sweet Cicely] {S3 in Minnesota}—In Minnesota, *O. depauperata* occurs only at a few sites in Cook County (Smith 1988). There are only four records in the NOPD (2008); two from Lake Superior, one from Lake Huron, and one along the Minnesota border in rocky woods of the Rove Formation at Arrow Lake.

My collection, from a low rich cedar forest, is probably a relocation of the only known site in QPP. This location may be the western end of a disjunct Lake Superior population (Smith 1988).

Gentiana rubricaulis Schwein. (Gentianaceae) [Redstem Gentian]—This gentian favors alkaline soils (Voss 1996). In the QPP/BWCAW area, it grows on lakeshores and in wet meadows, doing particularly well in beaver meadows (the bottoms of drained beaver ponds).

Apocynum sibiricum Jacq. (Apocynaceae) [Indian Hemp]—The NOPD (2008) has three records, one each at Lake Superior, Namakan Lake, and Lake of the Woods. Habitat in the QPP/BWCAW area is sandy lakeshores.

Asclepias incarnata L. (Asclepiadaceae) [Swamp Milkweed] (Figure 6)—Here in the northern portion of its range, the flowers have a more intense purple hue than farther south. There are no records in the NOPD (2008).

Clinopodium vulgare L. (Lamiaceae) [Wild Basil]—Monument Portage receives lots of traffic and most all of the portage has a disturbed open feel to it. Here, with lots of introduced weeds, Wild Basil flourishes. It also still grows at the original QPP location, one lake away. There are no records from northwest Ontario in the NOPD (2008).

Scrophularia lanceolata Pursh (Scrophulariaceae) [Hare Figwort]—This plant was added to the QPP flora after the publication of Walshe's flora (1980) on a report by Ahlgren (1989). There are no records in the NOPD (2008).

Utricularia minor L. (Lentibulariaceae) [Lesser Bladderwort]—Lesser Bladderwort is generally found in the QPP/BWCAW area in ponds associated with beaver activity. Voss (1996) notes that it is usually a calciphyte. There are two records, from north and east of Lake Superior, in the NOPD (2008).

Petasites sagittatus (Banks ex Pursh) Gray (Asteraceae) [Arrowleaf Coltsfoot]—Habitat in the QPP/BWCAW area is calcareous marshes and cedar swamps. All collection records in the NOPD (2008) are east of QPP.

FIGURE 6. *Asclepias incarnata* with *Carex lasiocarpa* on floating mat on Amik Lake, 5 July, 2007.

DISCUSSION

As one might expect from a study in the greenstone area of QPP, the vast majority of the significant plants found were calciphytes, which owe their rarity, or perceived obscurity, in the park to several interrelated factors: 1) the enormous size of the park coupled with the proportionally small amount of parkland underlain by greenstone; 2) the limited scope of previous botanical work that appears to have focused, probably because of time and effort required, only on a few narrow travel routes through the park resulting in the exclusion of vast amounts of remote (nearly inaccessible) wilderness; 3) the lack of intensive botanical work in the greenstone area which, although small in relation to the park as a whole, is itself a significant expanse of remote wilderness; and 4) the substantial effect of soil pH on plant composition producing in the calcareous

greenstone area a fairly extensive array of plants not found in other areas of the mostly acidic park.

Although nearly all the plants reported here as new records for the park are just that, there are a few plants that are actually taxonomic reassignments (e.g. *Gymnocarpium jessoense, Oenothera oakesiana*), or are in the middle of ongoing taxonomic confusion (e.g. *Dichanthelium acuminatum* subsp. *implicatum*), or although apparently new, may not be if older herbarium specimens were previously overlooked or misidentified (e.g. *Dryopteris expansa, Eleocharis elliptica*). It would be appropriate to have further review of past park collections of *Platanthera aquilonis, Oenothera biennis,* various species reported in the *Dichanthelium acuminatum* complex, *Rubus* subgenus *Eubatus*, and *Galium trifidum.*

There were a surprising number of pondweeds (ten) found that are important to the QPP flora. Seven of these, *Potamogeton foliosus, P. friesii, P. illinoensis, P. obtusifolius, P. strictifolius, Stuckenia filiformis* subsp. *alpina,* and *S. filiformis* subsp. *occidentalis*, are new to the park, and the other three, *Potamogeton praelongus, P. zosteriformis,* and *P. robbinsii*, had been found one, two, and three times, respectively. All of these pondweeds were collected in alkaline waters.

A number of important ferns were encountered in QPP. Of the eleven Ontario rare species collected, five are cliff ferns, *Cystopteris laurentiana, Gymnocarpium jessoense, Woodsia alpina, W. glabella*, and *W. oregana* subsp. *cathcartiana,* with two (or three) of them, *C. laurentiana*, *W. alpina*, (and *Gymnocarpium jessoense*), being new to the park. (A sixth cliff fern reported here, *Asplenium trichomanes*, is rare in Minnesota.) In total, seven significant ferns were found with only one, *Dryopteris expansa*, being a non-cliff dweller.

While many protected areas in North America face major problems caused by the spread of invasive alien species, QPP's native vegetation remains largely intact, with the aliens present confined to campsites and portages. So, it is no surprise that the park's four newly reported alien plants appear to be restricted to campsites.

Special mention must be made of the Emerald Lake area. There are now eleven (six newly reported in this paper) species (*Dryopteris expansa, Woodsia alpina, Woodsia glabella, Stuckenia filiformis* subsp. *alpina, Carex eburnea, Eleocharis flavescens* var. *olivacea, Nymphaea leibergii, Saxifraga paniculata, Potentilla nivea, Hypericum canadense, Osmorhiza depauperata*) known from in and around Emerald Lake that are unknown elsewhere in QPP. Two of these, *Eleocharis flavescens* var. *olivacea* and *Hypericum canadense*, from the muddy water line of an old beaver wetland on the north side of the lake, have never been found in northwest Ontario. Another plant, *Nymphaea leibergii*, reported only on Beaver ponds at Emerald Lake (Walshe 1980), is the only one of the eleven unique plants from this area that I was unable to locate. The soils must be unusually fertile, as enormous White Cedars, and Red and White Pines prosper in several places around the lake. In an ancient White Cedar forest along the Plough/Emerald portage where *Dryopteris expansa* and *Osmorhiza depauperata* thrive at their only known park location, one giant Cedar measures 13.5 feet in circumference at 4.5 feet above the ground. Although cliffs in the greenstone area of the park are not uncommon, most have a southeast exposure. The north-

facing cliffs on Emerald Lake are exceptional and support the park's lone stations for *Woodsia alpina* S2, *Woodsia glabella* S3, *Carex eburnea, Saxifraga paniculata,* and *Potentilla nivea* S2. Revealed only in the beautiful green-tinted waters of Emerald Lake is *Stuckenia filiformis* subsp. *alpina.*

Other significant plants found at Emerald Lake are: Ontario rare species, *Gymnocarpium jessoense* S3, and *Muhlenbergia racemosa* S3; new park species, *Potamogeton foliosus, Muhlenbergia glomerata, Carex pseudocyperus, Scirpus atrocinctus, Oenothera oakesiana, Hackelia deflexa,* and *Galium tinctorium*; and park rare species, *Asplenium trichomanes* (Walshe 1980), *Potamogeton praelongus, P. robbinsii, Leersia oryzoides, Carex castanea, C. hystericina, Eriophorum gracile, Calypso bulbosa* (Walshe 1980), *Malaxis unifolia* (Walshe 1980), *Arabis hirsuta, Ranunculus gmelinii* (Walshe 1980), *Ribes lacustre, Asclepias incarnata* (Walshe 1980), and *Petasites sagittatus.*

One species reported by Walshe (1980) from Emerald Lake, *Carex heleonastes,* is now believed to have been a misidentification, perhaps of *Carex canescens.* No specimen can be found to support the report, and QPP appears to be out of the range of this arctic species (Oldham, personal communication, 8 May 2007).

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CONTENTS

Vascular Flora Additions and Noteworthy Collections from
Quetico Provincial Park, Ontario
Perry A. Scott 1

On the cover: *Old growth Great Lakes Pine Forest (a characteristic Quetico forest type with Pinus resinosa and Pinus strobus as dominants) in Quetico Provincial Park at Chatterton Falls, Photo taken by Perry Scott, 1 August 2008.*

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THE GREEN ALGA *ASKENASYELLA* (TETRASPORALES) IN MICHIGAN

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ABSTRACT

The green alga *Askenasyella chlamydopus* is reported for Michigan for the first time. The genus *Chaetochloris* is shown to be a taxonomic synonym of A*skenasyella* and the species described within the former genus are transferred to *Askenasyella*. *Askenasyella*, traditionally placed in the family Palmellaceae, is shown to possess pseudocilia, and thus is more correctly placed in the family Tetrasporaceae.

KEYWORDS: *Askenasyella*; *Chaetochloris*; Tetrasporaceae

INTRODUCTION

The genus *Askenasyella* was described by Schmidle (1902) with the single species, *A. chlamydopus*. The generic name refers to the Russian-German phycologist Eugena Askenasy. The genus was regarded by Schmidle as in the Xanthophyceae. In 1905, West & West described the taxon *Actinobotrys confertus*. Soon after, West & West (1906) recognized that their genus was congeneric with Schmidle's *Askenasyella* and they transferred their species to that genus, as *Askenasyella conferta* (W. West & G.S. West) W. West & G.S. West. Printz (1927) continued to assign *Askenasyella* to the Xanthophyceae, that is, the Botryococcaceae within his "Heterocontae". Printz recognized two species, *A. chlamydopus* and *A. conferta*. Pascher (1939) observed the presence of starch and thus transferred *Askenasyella* to the green algae, placing it in the family Palmellaceae, order Tetrasporales. Pascher stated that *A. conferta* was incompletely or not fully observed and that even if recognized as distinct, it may even be a taxon belonging to the genus *Stichogloea* Chodat. Ramanathan (1968) described a third species from India, *A. randhawai*. *Askenasyella chlamydopus* has been rarely reported from North America (Smith 1950; Woodson & Holoman 1964). The latter record was repeated by Dillard (1989).

The current placement of *Askenasyella* is in question. Some phycologists (Pascher 1939; Smith 1950) place the genus in the family Palmellaceae whereas Bourrelly (1966) assigned it to the Radiococcaceae. Dillard (1989) placed it in the Oocystaceae of the Chlorococcales. Indeed, in the most recent systematic and ecological treatment of nonmotile coccoid and colonial green algae for North America (Shubert 2003), no attempt was made to place *Askenasyella* in a particular order or family. Based on observations of Kansas and Michigan sam-

ples containing *Askenasyella*, I make additional observations on its morphology and present a resolution of ordinal and family placement.

MATERIAL AND METHODS

Plankton samples were collected from an I-70 turnpike marsh, Douglas County, west of Lawrence, Kansas, July 1968. Additional samples containing *Askenasyella* were collected from Miller's Marsh, Charlevoix County, Michigan, July, 1990. Maintenance cultures were grown in Bold's Basal Medium (1967) or soil water extract. Cultures no longer survive.

RESULTS AND DISCUSSION

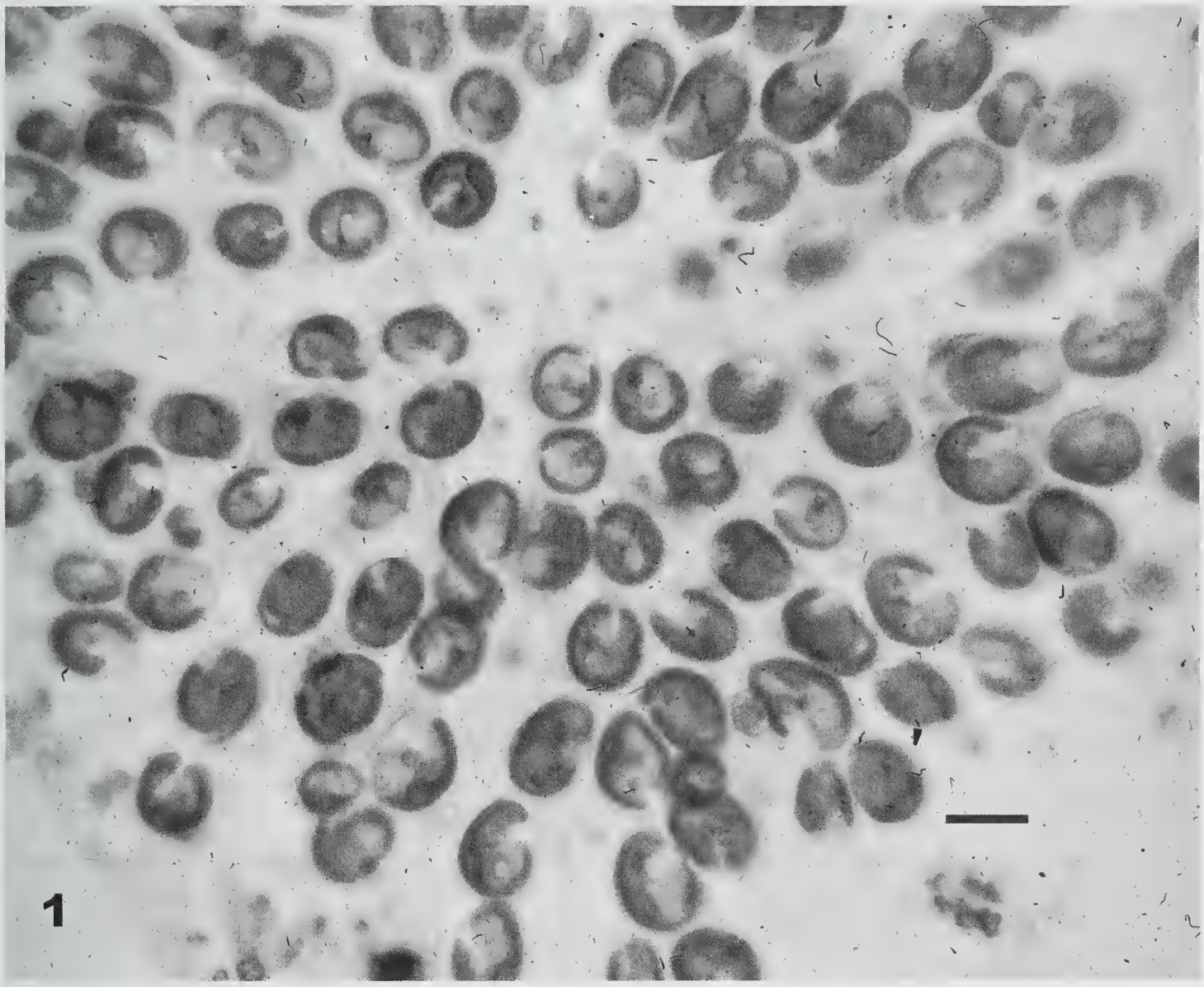
The anterior end of the cell is at first truncated presenting a flat surface of contact with the substratum (Figs. 1–2). As a colony becomes crowded, the mutual pressure forces the cells away from the surface and the anterior position of the cell envelope becomes pointed. With further secretion of gel the individual cells come to lie remote from one another. The contiguous portion of the two pseudocilia from protoplast to apex is clearly evident (Fig. 2). This condition also arises in small colonies under observation with the microscope. It is thought that here both the pressure of the cover slip and subsequent additions of distilled water to the mount produce the change. In this condition if one failed to observe the pseudocilia, and they are nearly invisible when unstained, one could only determine their material as *Askenasyella*. The only clearly distinguishable portion of the pseudocilia is that which traverse the anterior part of the cell. Bourrelly (1966) was aware of the presence of pseudocilia and stated that "perhaps pseudoflagella" (French translation) were present as was Dillard (1989; called delicate threads). Neither author, however, acknowledged their presence in their systematic placements of the genus.

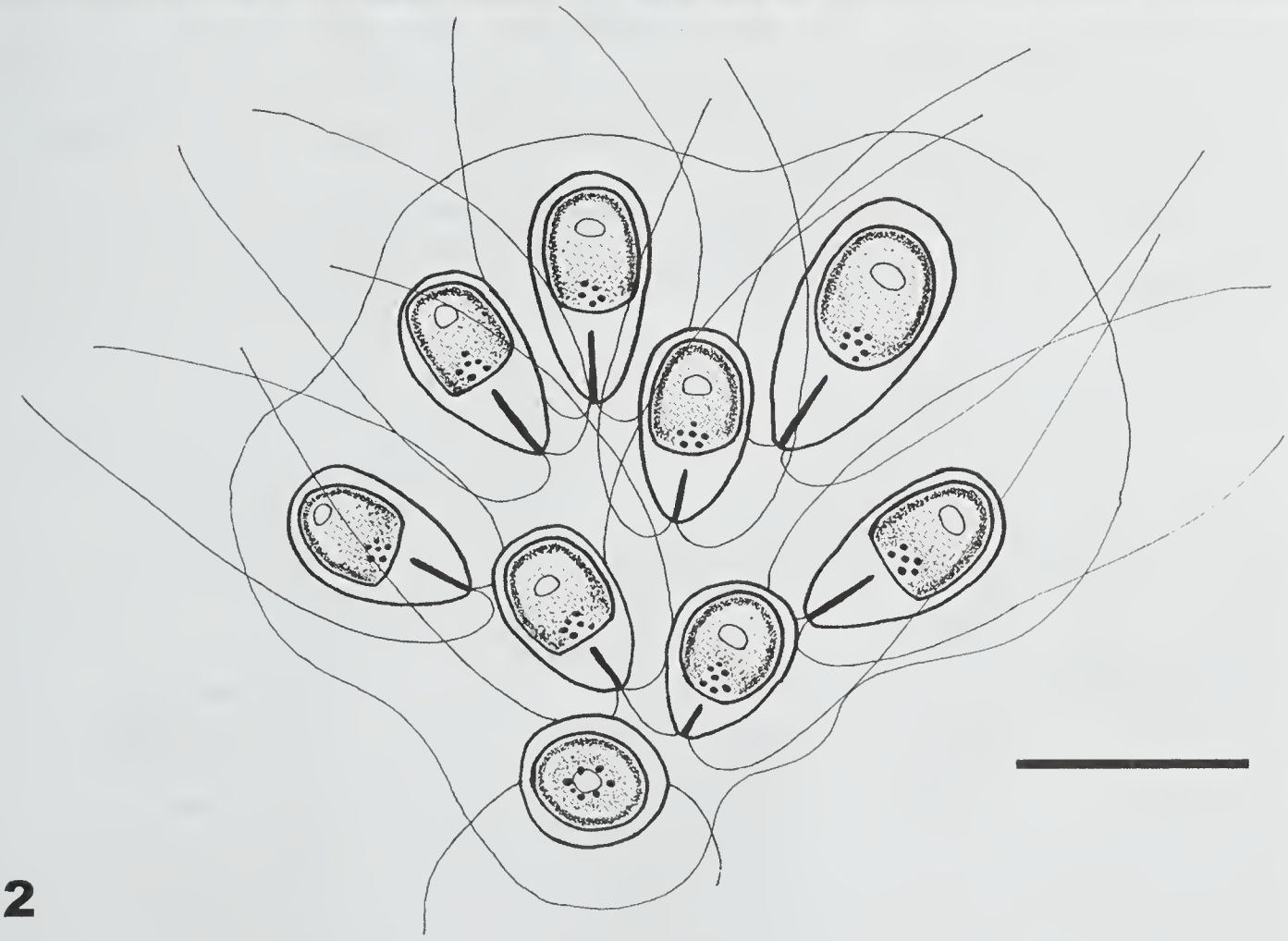
The writer is certain that just such a failure in observations led to the earlier reports of *Askenasyella* in Kansas (Thompson, in Smith 1950) and Virginia (Woodson & Holoman 1964). The writer is further of the opinion that the description of *Askenasyella* was also based on such an incomplete observation. Because there are no other differences between this genus and *Chaetochloris* Pascher & Korshikov (in Korshikov 1932) and because *Askenasyella* has priority, the species of *Chaetochloris* are transferred to it. Furthermore, as the only morphological feature which can be used to separate *Askenasyella randhawai* and *A. chlamydopus* is size, the latter being ca. 2 μm shorter and narrower, I conclude that those two taxa are conspecific.

A. chlamydopus Schmidle 1902: 154, 157, figs. 1–3; the generitype
=Synonym: *A. randhawai* Ramanathan (1968: 116, figs. 1–10)

A. consociata (Pascher & Korshikov) Wujek nov. comb.
=Basionym: *Chaetochloris consociata* Pascher & Korshikov (in Korshikov 1932: 594, figs. 67, 68)

A. asocialis (Pascher) Wujek nov. comb.
=Basionym: *Chaetochloris asocialis* Pascher (1940: 144, figs. 7–8, 9d)





FIGURES 1–2. A*skenasyella chlamydopus*. 1. Whole colony. 2. Cells each with two pseudocilia. Scale bar = 10 μm.

A. depauperata (Pascher) Wujek nov. comb.
=Basionym: *Chaetochloris depauperata* Pascher (1940: 143, figs. 1, 3, 5, 9c)
A. scherffeliana (Pascher) Wujek nov. comb.
=Basionym: *Chaetochloris scherffeliana* Pascher (1940: 144, figs. 4, 9b)
=Basionym: *Chaetochloris indica* Iyengar: 1975, 29, fig. 1)

Calcite may be crystallized out in the colonial gel and in such quantity that individual cells come to lie in pockets or deep wells in the mass. When stained with methylene blue the colony gel shrinks. Before that it stains bright red-violet and exhibits a radiate structure. Through this gel run the pseudocilia which seem to take very little of the stain and become only slightly more visible. The pseudocilia and the striae of dense gel became more apparent when stained with potassium iodide.

In summary, based on the morphology of the above newly described presence of pseudocilia in *Askenasyella*, it is best placed in the order Tetrasporales, family Tetrasporaceae and not as previously treated (Table 1). Molecular data on *Askenasyella* and other members of the family including the closely related genus *Polychaetochloris* (Pascher 1940) are needed to establish if this is a natural family.

Key to the species of *Askenasyella*:

1. More than two pseudocilia per cell ..... *Polychaetochloris*
1. Only two pseudocilia per cell ..... 2.
2. Papilla at bases of pseudocilia not conspicuous ..... *A. chlamydopus*
2. Conspicuous papilla between bases of pseudocilia ..... 3.
3. Colony four or fewer cells ..... A. *asocialis*
3. Colony multicellular ..... 4.
4. Cells lacking stigmata and pyrenoids (stigmas present in zoospores) ..... *A. depauperata*
4. Cells with stigmata, with or without pyrenoid ..... 5.
5. Cells longer and more slender than in other species, stigma large in upper-third of cell ..... A. *scherffeliana*
5. Cells broadly elliptical-egg shaped to almost spheroidal, axial pyrenoid; zoospores lack stigma ..... *A. consociata*

TABLE 1. Systematic placement of *Askenasyella*.

Author	Class/Order	Family
Schmidle (1902)	Xanthophyceae	
West & West (1906)	Confervales	Chlorotheciaceae
Printz (1927)	Xanthophyceae	Botryococcaceae
Pascher & Korshikov (1932)	Tetrasporales	Pseudociliaceae
Pascher (1939)	Tetrasporales	Palmellaceae
Smith (1950)	Tetrasporales	Palmellaceae
Bourrelly (1966)	Chlorococcales	Radiococcaceae
Ramanathan (1968)	Chlorangiales	Chlorangiaceae
Dillard (1989)	Chlorococcales	Oocystaceae
This study	Tetrasporales	Tetrasporaceae

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DEMYSTIFYING NOMENCLATURE: THE GAME OF THE NAME

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ABSTRACT

Unlike "common names," which vary with region, language, and other circumstances, scientific names should be constant and applicable in all cultures for the same concept. Thus, they are Latin or treated as Latin, subject to the rules of that language and to the provisions of the *International Code of Botanical Nomenclature* regarding formation and proper original publication, as well as fixation of their application by designation of "types."

KEY WORDS: Code, names, nomenclature, types

T. S. Eliot (1939 p. 11) began one of my favorite poems: "The Naming of Cats is a difficult matter, it isn't just one of your holiday games;" The naming of plants is at least as difficult a matter. It's not exactly a holiday game, and for scientific names we do have to operate according to the rules. The present essay is intended as an introduction to and some background for a series of occasional discussions about "name changes" for certain of our familiar plants. I hope also to encourage proper use of terms that may be common words but have a specialized application in nomenclatural contexts.

"Why are they always changing the scientific names of plants?" is a question often heard or muttered. There is sometimes even a complaint about divergent "common" names (which are in fact often merely attempts at literal translation of scientific names). So, first, a word about these. True common names—that is, in common use—vary with one's native language and even among traditions or usage within the same country. Plants that occur in countries with different languages or different uses will, of course, have different common names for the same plants. French Canadians will probably use different common names than do their anglophone countrymen. Even in the same language, there may be several or even many common names in truly common usage for a plant. Attempts at literal translation of scientific names are usually not truly common names. They may be English (or French, or Chinese) names but not in fact in common vernacular use.

In contrast, Latin is a "dead" language, not official in any country, and there is a well-established Latin vocabulary for plant descriptions. Grammatical rules are stable. As the common language of scholars two and more centuries ago, Latin facilitated communication (for example, Linnaeus, a Swede, could readily communicate with scholars in other countries and rapidly earn his doctoral degree in Holland by writing in Latin). In order to validate publication of the name for a species, genus, variety, subspecies, etc. new to science, at least

a brief descriptive Latin diagnosis is now one of the requirements in the *International Code of Botanical Nomenclature* (ICBN)—of which the latest edition was authorized at the International Botanical Congress held in Vienna, Austria, in 2005.

Although Latin as a language is relatively unchanging (except as modern concepts may require some form of Latinization for a new term), botanical science, like others, does change. There are internationally sanctioned "rules" in the Code, which governs the formation and application of scientific names of plants, but there can be no such "rules," internationally agreed upon, for what defines a species and other levels of classification. *The rules of nomenclature deal with naming, not with science itself.* So when one of your favorite little wildflowers starts to appear in the literature under a different scientific name than the one you grew up with (and which for many people is the "right" name!), that generally means one or both of two things: (1) the long-familiar scientific name has been shown to be contrary to the rules of the International Code; or (2) the plant involved is believed (at least by some) to be more accurately classified in a way different than the familiar one—so of course the name may need to be different.

For an example, consider the common "Threesquare" sedge long called *Scirpus americanus* by all who encountered it in marshes and on wet shores. When it was discovered that this name, as originally published, in fact applied to a different plant, the next oldest available name that applied to what had been termed *Scirpus americanus* turned out to be *Scirpus pungens*. So it became necessary to displace the well known name. One of the primary rules of nomenclature is the one of priority and *pungens* had priority of publication. More recently, botanists widely agree that this species and its closest relatives are different enough from *Scirpus* that they should be placed (classified) in a distinct genus. If this taxonomic position is accepted, then it becomes necessary to treat our common "Threesquare" as *Schoenoplectus pungens*. There is no rule against calling the plant *Scirpus pungens* but that indicates acceptance of a broader concept for the genus *Scirpus* than most current botanists who work with those plants accept.

To summarize in a somewhat different way: nomenclature is based on certain rules, and is contingent: *If* something . . . *then* something . . . . The name depends on how the organism to be named is classified. The business of the botanist is to determine what needs a name: is it a distinct species, a variety or subspecies, merely a color form? In what genus—or is it sufficiently distinct to require recognition of a new genus? Once such taxonomic decisions have been made on the basis of scientific evidence, then the rules of nomenclature kick in to enable provision of a new name or application of an older previously published name if any.

The whole matter is very much like any other aspect of language. What is a chair? A seat with four legs and a back? Without a back, would it be a stool? If it seats more than one person is it a bench? What covers everything called a chair? What do you call a piece of canvas supported by metal tubing with no distinction between seat and back? Words (and names) are applied to objects or concepts with some defining characters in common. You have a plant with

parallel-veined leaves and with flowers that are bilaterally symmetrical and have an inferior ovary and a single cotyledon in the seed. So you correctly call it an orchid. Suppose you find in a remote tropical jungle a plant with flowers that look like those of an orchid. Does it belong to one of the nearly 20,000 species of orchids already described and named in over 700 genera, or is it new to science? If you conclude the latter (after a massive search in literature), then there are rules for publishing the name of a new species (and/or genus) according to the Code. Thus goes the distinction between taxonomy (science) and nomenclature.

A word here about relevant adjectives: Some dictionaries (not to mention a great deal of sloppy usage) are confused regarding the distinction between "nomenclatural" and "nomenclatorial." "Nomenclatural" is an adjective derived from "nomenclature," which refers to the *system* of scientific names: their formation, proper publication, rules, and similar provisions for formation and use. The *International Code of Botanical Nomenclature* includes all these provisions and is revised at 6-year intervals during International Botanical Congresses. A "nomenclator" is a list or index or catalog of names—or a person who compiles such a list or catalog. "Nomenclatorial," then, is the proper adjective to refer to nomenclators and titles may even include an obvious reference, e.g., *Nomenclator Zoologicus*, which was published in 1939 to list all known generic names published for animals. The *Index Kewensis* is a series of volumes listing newly published names of plants; it is a nomenclator although that word does not appear in the title.

THE NATURE OF SCIENTIFIC NAMES

Almost everyone recognizes that the scientific name of a species of plant or animal consists of two words. The first is the name of the genus, and the second is termed by botanists the specific epithet (for it designates the particular species within its genus). Zoologists, who have their own Code, call the second word the species name but botanists insist that the species name is the full two words. This system of two-word designations for species was first applied consistently to all known (at least to him) plants (in 1753) and animals (in 1758) by the great Swedish naturalist, Carl Linnaeus. (Years later he was ennobled and then could be called von Linné, a form preferred by many zoologists.) The 300th anniversary of Linnaeus' birth was celebrated in May of 2007. Many newspaper articles and other popular accounts declare that Linnaeus is remembered for his system of classification. This is not true! He is remembered for his system of *naming*, which is used throughout the world to this day.

The generic name is always to be treated as a noun. The species epithet, however, may be an adjective modifying that noun, in which case it must agree with the gender of the generic name, according to the rules of Latin grammar. (Thus, we have the masculine *Symphoricarpus albus* for snowberry, the feminine *Spiraea alba* for meadowsweet, and the neuter *Chenopodium album* for lambsquarters.) Or the specific epithet may be a different noun (grammatically consid-

ered to be in apposition with the generic name). The epithet in mullein, *Verbascum thapsus*, for instance, is an old classical name. Often the specific epithet is a genitive (possessive), either singular or plural, masculine or feminine. Thus we have *Cirsium hillii* for Hill's thistle (named for Rev. Ellsworth J. Hill); *Crataegus coleae* (a hawthorn named for Emma J. Cole, of Grand Rapids, Michigan); *Rubus florenceae* (a blackberry named for Florence N. [Mrs. Clarence R.] Hanes, of Kalamazoo County); and (in far northwestern North America) *Potamogetom porsildiorum* (named for the Canadian brothers Alf E. and Robert T. Porsild).

The transfer of a species from one genus to another, therefore, may require changing the termination on an adjectival species epithet if the name of the new genus has a different gender in Latin. A potentially confusing name is borne by our pale dogwood: *Cornus amomum* subsp. *obliqua*, where the generic name is feminine (as were Latin names for trees ending in *-us*—which is usually a masculine ending), the species epithet is a neuter noun (an old Latin name in apposition), and the subspecies epithet a straightforward feminine adjective agreeing in gender with the generic name.

There is, incidentally, no requirement of common sense that the species epithet be accurate if it refers to some aspect of the plant nor that, if it refers to a person, the person should have had some connection with discovery or understanding of the plant. A name or specific epithet may even be complete nonsense. The genus *Filago*, originally described by Linnaeus and referring to thread-like hairs, led to four anagrams when that genus was split up by Cassini, a 19th century French specialist on Compositae, who named segregate genera for certain of the species: *Gifola*, *Ifloga*, *Logfia*, and *Ogilfa*. These are validly published names, whether or not one accepts the "splitting" classification that they represent. The frequent advice that one can learn something about the characteristics or origins of plants from their names is also less than universal truth. Under the Code, names may not be rejected merely because they are inappropriate, offensive, or even inaccurate, When Linnaeus named *Asclepias syriaca*, the common milkweed, a native of North America, he thought that it had come from Syria. Similarly, *Impatiens capensis*, our common touch-me-not or jewelweed, was erroneously thought to have originated at the Cape of Good Hope in Africa. Geographical concepts of Virginia, Carolina, Canada, and other places were often rather vague to European botanists in the 18th Century. ["Virginia" at one time extended west to the Mississippi and it has been noted that Linnaeus ascribed nothing to any area in North America between "Virginia" and "Canada".] Similarly, we may not reject the epithet in *Lycopus uniflorus* merely because in fact plants of that species bear more than one flower!

It is customary, in formal usage, to follow the name of a taxon (a unit of classification at any level (species, variety, family, etc.) with the name or names of the person(s) who authored that scientific name. Much popular lore notwithstanding, the names of authors are *not* part of the scientific name. The botanical and the zoological codes both declare that the name of a species consists of two words; the name of the genus and the epithet for the species. The name(s) of its authors may *optionally* be added after or following it! Authors'

names, which are usually abbreviated if long or well known, often provide a helpful quick bibliographic clue as to where the name might have been published, and when. They also distinguish between homonyms, that is, identical names published by different authors. For example, a common dune willow is *Salix cordata* Michx., indicating that it was named by the French botanist André Michaux in his pioneering flora of North America published in France in March of 1803. Unfortunately, the American botanist G. H. E. Muhlenberg published the name *Salix cordata* at least two months later in 1803—but for an entirely different willow (now known as *Salix eriocephala* Michaux). *S. cordata* Muhl. being a later name identical to Michaux's, even though applied by him to a different species, is said to be "illegitimate," i. e. contrary to the rules (see below). Note that we are talking of *authors* of published works that include names. The author of a name is not necessarily an "authority," i. e. an expert or specialist on the plants involved: their identification, distribution, family or other relationships, DNA, cultivation, etc.

VALID OR LEGITIMATE?

One sometimes reads of a "valid species," an unfortunate use of that word. For example, the journal *BioScience*, in two places in 2005, used careless language in this regard: "Unlike other disciplines, in which species described according to the rules remain valid until determined invalid by further research," . . . and "species formerly synonymous". Names, not species, may be synonymous! The Code considers a name to be "valid" or "validly published" if its publication meets all of the several requirements for publication of a new name, including (currently) at least a brief Latin diagnosis or description and designation of a type (see below). On the other hand, a "legitimate" name is a validly published one that also meets certain requirements for usage, e.g., not a homonym (e.g. *Salix cordata* Muhl.) of an identical prior one, is not antedated by another name applied to the same taxon, nor is it described with reference to a prior name that ought to have been adopted (i.e., is not "superfluous"). Deciding whether something is a "good" or acceptable species (or genus, etc.) is a scientific or taxonomic judgment, not a nomenclatural one. But one does first have to decide, on a scientific basis (position, rank, and circumscription are the key scientific issues), what needs a name before its proper nomenclatural disposition can be determined.

SYNONYMS

Often one hears of "synonyms" without realizing, perhaps, that there are two basic kinds in nomenclature. "Taxonomic synonyms" (or as the zoologists call them, "subjective" synonyms) are two or more different names published for the same organism at the same rank (such as genus or species). Ordinarily the oldest name to be published at the same rank is the one to be used; the later synonym (sometimes called by zoologists a "junior" synonym), even if validly

published, is illegitimate (see above). On the other hand, "nomenclatural synonyms" (termed by zoologists "objective synonyms") are two or more names that are based on the same type (see below)—usually through error or else by change in rank (e, g., recognizing a subspecies or variety at the rank of species).

TYPES

One of the most frequently misunderstood aspects of nomenclature is the function of types. A type is not simply a representative specimen of some kind that illustrates a species or other taxon. That is, it's not necessarily "typical" in the variational sense of the word. It is a very special specimen, however, that determines application of a name—even if it turns out to have been an extreme variant within the species to which it belongs. Many species when first named as new to science were not well enough known for the namer to be aware of the full range of variation of the taxon. But it is now obligatory to specify a type, an individual specimen to which the name applies. And the name will also apply to all other specimens that one deems to belong to the same taxon.

The role of a type is very aptly expressed in the excellent work by Jeffrey (1973, p. 19): "It is not the purpose of a type to be typical in the variational sense; the purpose of a type is to provide a fixed point associated with a name in the range of variation of organisms so that no matter where discontinuities are found to occur and boundaries between taxa drawn, the application of the name can be objectively and unequivocally decided." In other words, a name cannot be applied in such a sense that its type would be excluded.

So types are very important in applying and retaining names when taxa are split and in interpreting intentions of prior authors; they thus contribute to stability in nomenclature. The type concept is relatively new (20th century) and retroactive designation of types for older names that lack them does help to reduce confusion in nomenclature. Most large herbaria keep their types in designated cabinets where they will receive minimal routine handling and maximum care in case of emergency.

Finally, remember that it is names, not taxa, that have types. There is no such thing as the "type of a species."

ACKNOWLEDGMENTS

I am grateful to Rogers McVaugh for first instilling in me a fondness for nomenclatural issues and to the many colleagues from around the world who sustained that interest while serving on the Editorial Committee for the *International Code of Botanical Nomenclature* during the years (1969–1993) that I was secretary or chairman of that committee.

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NOTEWORTHY COLLECTION

OHIO

Pluchea odorata (L.) Cass. (Asteraceae). Saltmarsh fleabane.

Previous knowledge: *Pluchea odorata* is distributed along the Atlantic coast from Massachusetts to Florida, along the Gulf coast, southwest U.S. and tropical America; rarely inland in the Mississippi valley and Great Lakes region of Illinois, Indiana, Michigan, and Ontario Canada (Nesom 2006). Populations nearest Ohio are from Livingston and Wayne counties, Michigan where it was last collected in 1932 (Voss 1996). It was collected in 1976 in Cook County, Illinois, and occurs in Lake County, Indiana (Swink and Wilhelm 1994). In Pennsylvania, *P. odorata* occurs outside of the Great Lakes region, mostly near the Atlantic coast (Rhoads and Klein 1993). *Pluchea odorata* has not been reported for Ohio prior to this discovery (Cooperrider *et al.* 2001; Moseley 1899; Nesom 2006).

Diagnostic characters:

Pluchea odorata is a fibrous-rooted annual up to 20 dm tall with pinkish purple flower heads in a flat-topped inflorescence (Figure 1). Leaves are alternate and are either lanceolate or ovate shaped. Blooming period is from August to September. *Pluchea odorata* is separated into two varieties based on plant size and number of functional staminate flowers. The Ohio population represents the variety *succulenta*. *Pluchea odorata* is similar to *P. camphorata*, which is endangered in Ohio, but differs by a viscid pubescent not nearly glabrous or merely glandular involucre.

Significance of the report: This is the first collection of *P. odorata* for Ohio. A dozen individuals were found at Sheldon Marsh State Nature

FIGURE 1. Photo of *Pluchea odorata* taken from Sheldon Marsh State Nature Preserve, Erie County, Ohio (Photo by Patricia Deering).

Preserve in Erie County. Sheldon Marsh is one of the last and best examples of a coastal marsh remaining along Ohio's Lake Erie shore. *Pluchea odorata* was growing on mudflats of the marsh. The area where the population was discovered was once infested with the non-native, invasive *Lythrum salicaria*. Over the last few years the Ohio Division of Natural Areas & Preserves has been eliminating this species from the area to the point it is now rare. *Pluchea odorata* was growing in association with: *Ammannia robusta*, *Eleocharis acicularis*, *E. intermedia*, *E. obtusa*, *Cyperus diandrus*, *C. erythrorhizos*, *C. odoratus*, *Epilobium parviflorum*, *Lindernia dubia*, and *Lythrum salicaria*. Coordinates for the site are N 41.42968769 W –82.62114082. The associates found with *P. odorata* at Sheldon Marsh are similar to those reported by Swink and Wilhem (1994) for Lake George, Indiana.

The Ohio population was not likely a deliberate, human introduction to this natural area. It is considered adventive in Illinois, Indiana, Michigan and Ontario Canada (Fernald 1950; Swink & Wilhelm 1994). Based on its non-native status in adjacent states the Ohio population is likely adventive.

Specimen citation: ERIE CO.: Exposed mudflats behind barrier beach, Sheldon Marsh State Nature Preserve, Huron Twp., 5 Sep 2007, *Gardner, T. Arbour, and D. Boone 5500* (OS).

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NOTEWORTHY COLLECTION

WISCONSIN

Euonymus obovata Nutt. (Celastraceae). Running Strawberry-bush

Previous knowledge. This low, sprawling shrub ranges from western New York to Michigan, south to West Virginia, Kentucky, and Missouri (Gleason and Cronquist 1991). It is at its northern limit in Michigan, where it grows in various kinds of deciduous woods including swampy woods, upland beech-maple, and oak-hickory (Voss 1985). It is not found in the Upper Peninsula but has been found in the counties bordering Lake Michigan north to Muskegon County (Voss 1985). *Euonymus obovata* is also found in scattered locations throughout Illinois. It has been recorded from Will, DuPage, Cook, and Lake Counties (Swink and Wilhelm 1994). These collections are the closest to the Wisconsin border that it has been found.

Significance. *Euonymus obovata* is a shrub that was previously unknown in Wisconsin. It was collected in Milwaukee County three times in the late 1970's in Doctor's Park and Grant Park, and in Grant Park in 1939. The two collections from Doctor's park were from low, wet woodlots and one is labeled as having been a "large colony". The 1970's collection from Grant Park was in a ravine near Lake Michigan. The 1939 collection from Grant Park contains no information regarding its location and habitat. These two parks have relatively good quality remnants of mesic woods where the specimens were found. The specimens were not attributed to the flora of WI perhaps because of their being found in a park setting under the assumption that they were planted there. The parks do have large populations of exotics, and some planted ornamental species, however, it is unlikely that *E. obovata* was planted, as it is not at all common in the horticultural trade (Dirr 1998). Neither park was visited to see if the colonies are still present.

The newer collection (Zaborsky 00001), made in 2005, is from Outagamie County and indicates the bona fide occurence of *E. obovata* in Wisconsin (Fig. 1). This is 125 miles away from Lake County, Illinois and 119 miles from Grant Park. The specimen was collected from a large population in a sugar maple-basswood woodlot. The woodlot is in the middle of farmland but has low levels of exotics and an extremely rich herbaceous community. *Podophyllum peltatum, Maianthemum canadense, Erythronium albidum, E. americanum, Claytonia virginiana, Sanguinaria canadensis, Anemone quinquefolia,* and *Allium tricoccum* are all extremely abundant in the area and grow alongside and within the very large colony of *Euonymus obovata*. Woody associates include *Acer saccharum, Tilia americana, Viburnum lentago, Prunus virginiana*, and *Fraxinus pennsylvanica*. After talking to the owners, who have owned the property for three generations, it was learned that the woodlot has had very little disturbance. The only species planted in it were *Picea pungens* and *P. glauca* along the field borders. A few trees were harvested for firewood in years past and a small pond was made for field runoff. The low level of exotics and high concentrations of spring wildflowers, and of *E. obovata* itself, would seem to rule out man-made introduction of this species.

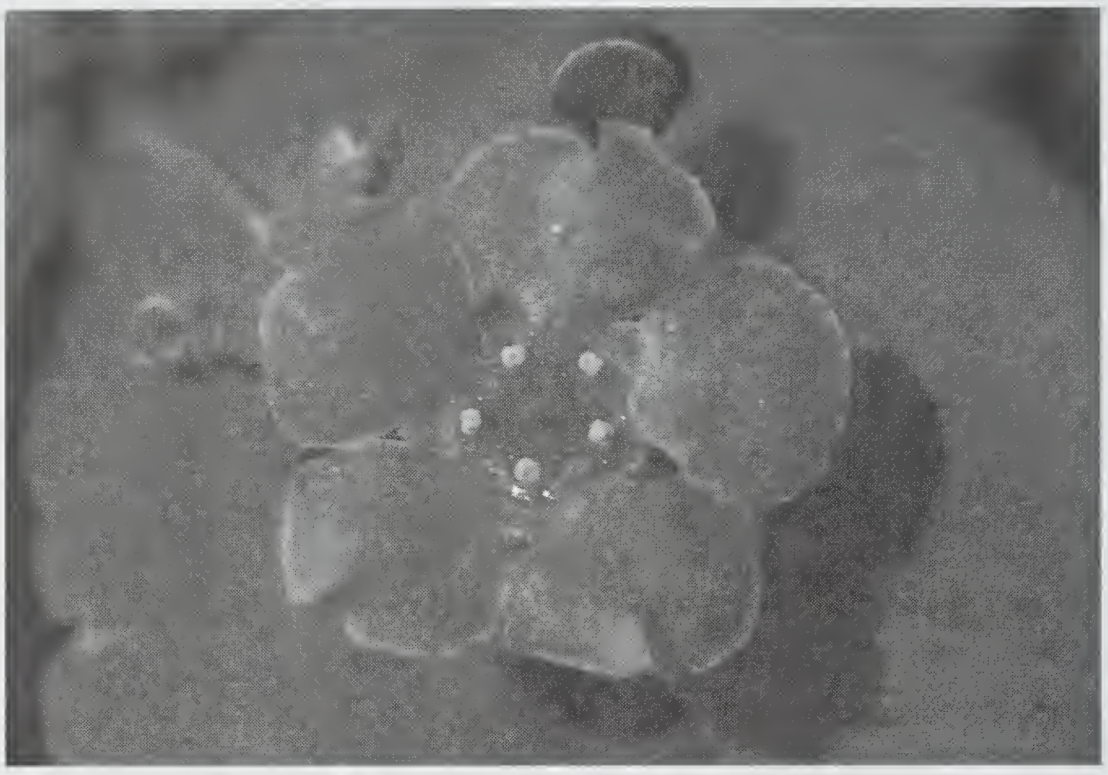

FIGURE 1. Flower of *Euonymus obovata* Nutt. taken at site of Outagamie County collection in May 2008 (Photo by John Zaborsky).

Specimen Citation. OUTAGAMIE CO.: Second growth sugar maple-basswood woodlot with many mesic native species. Several substantial colonies of this shrub in fruit. About 400 m SW of jct. of CTH A and CTH O. Center of NE4, 22N 17E 29 CNE4, 11 Sept 2005, John G. Zaborsky 00001 (UWSP). MILWAUKEE CO.: Grant Park. Grant Park Nursery. 16 August 1939, R.V. Schmidt 632. MILWAUKEE CO.: Fox Point and Bayside. Sandy or open fields near Lake Michigan and cool ravines off lakeshore. Found in a dense mat covering 60ft^2 in a low wet woodlot. Doctors Park T8N-R22E Sec. 10. 5 June 1976, Thomas Olesiak 76-333 (UWSP). MILWAUKEE CO.: Fox Point and Bayside. Sandy or open fields near Lake Michigan and cool ravines off lakeshore. Prostrate, large colonies adjacent to a creek near an open woodlot. Doctors Park T8N-R22E Sec. 10. 21 Aug 1976, Thomas Olesiak 76-775 (UWSP). MILWAUKEE CO.: Grant park ravine near Lake Michigan. Damp woodlot. T8N-R22E. 14 May 1977, Thomas Olesiak 77-255 (UWSP).

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NOTEWORTHY COLLECTIONS

MINNESOTA

Syringa reticulata (Blume) H. Hara subsp. *reticulata.* (Oleaceae). Japanese tree lilac.

Previous knowledge. Syringa reticulata subsp. *reticulata* is a deciduous tree that is native to Japan. Ishizuka (1974) described it as conspicuous in the shrub layer of lowland deciduous forests on Hokkaido and mountain floodplain deciduous forests on Honshu. On Hokkaido, Sargent (1894) reported it growing as tall as 30 feet, whereas Wilson (1928) stated that 45-foot heights were frequent. Recent treatments have given it subspecific (Chang et al. 1996) or varietal (Li et al. 2001) rank. It is a popular horticultural subject because few other cold-hardy trees have showy mid-summer inflorescences. Its spreading from cultivation has been reported for New York and three New England states (Springer and Parfitt 2007; USDA 2009). Japanese tree lilac has apparently not been reported as being a non-cultivated member of the flora elsewhere in North America.

Significance. Establishment of numerous *S. reticulata* subsp. *reticulata* saplings in a northern hardwood forest was observed in Duluth, Minnesota. Parent trees had evidently been planted on a residential lot near the edge of this forest decades ago, as several large individuals fruited in the immediate vicinity; closed-canopy forest now surrounds some of these fruiting tree lilacs. Saplings up to 2.5 m tall were common within 20 m of the nearest fruiting individual, but none were farther away than this. Five to 18 xylem rings were counted among 34 saplings between 0.5 and 2.5 m tall after they were severed near the trunk base. The six stems that had 15 or more rings ranged from 1 to 2.5 m tall, indicating that these saplings could live in a suppressed state for a number of years. A capacity to grow very slowly for many years beneath the overstory, then extend more rapidly in light made available after small canopy gaps infrequently appear, is known in *Acer saccharum* and *Fagus grandifolia* (Canham 1985, 1990), shade-tolerant tree species of Nearctic northern hardwood forests. We interpret this to mean that there is a reasonable probability that some of these lilac saplings could eventually reach reproductive status, at which point naturalization could be said to occur. Sax (1930) suggested that this taxon is self-fertile. The fruiting plants surrounded by forest canopy received full sun at the tops of their crowns, some of which reached 11 m in height, and the saplings would presumably need to achieve a similar canopy position in order to produce seeds. The saplings were growing in deep stony sandy loam with moderate drainage. This seems to be the first report of this taxon's escape from cultivation in the upper Great Lakes region. The specimens cited are from a putative parent of some of the saplings, which was probably planted deliberately.

Specimen citations. Minnesota. St. Louis Co.: W side of East Branch of Tischer Creek, Duluth, NE¼ Sec. 11, T50N R14W, in flower, 10 Jul 2008, *Schimpf*

and L. Bollin 486 (DUL, MIN), same plant, in fruit, 17 Sep 2008, *Schimpf and L. Bollin 499* (DUL, MIN).

Hypericum maculatum Crantz subsp. *obtusiusculum* (Tourlet) Hayek. (Hypericaceae, treated as Clusiaceae by some). Spotted St. John's wort.

Previous knowledge. Hypericum maculatum is a rhizomatous perennial forb that is native to western Eurasia and introduced in British Columbia (Robson 2002). Robson (2002) recognized two diploid subspecies and one autotetraploid subspecies, *obtusiusculum*, the latter being the one collected from Canada. Although it is rare for this species to be advertised by commercial horticulture, Norman K. B. Robson (personal communication) reports that it is occasionally cultivated in the United Kingdom and believes that the British Columbia populations are escaped from cultivation. It appears that *H. maculatum* has not been reported from outside of cultivation elsewhere in North America (USDA 2009).

Significance. A colony of *Hypericum maculatum* subsp. *obtusiusculum* in Duluth, Minnesota appears to be the first to be reported growing outside of cultivation in the United States. The stems are evenly spaced across about 8 m^2 and stand 6–8 dm tall. The soil is well-drained and the colony is in moderate deciduous shade. This colony is on the edge of a public park, and deliberate planting seems the most likely explanation for its origin. The vegetation in the immediate vicinity does not appear to have been maintained for some time. Although the St. John's wort appears to be thriving, there was no evidence of spread by seed beyond the rather sharply defined edge of the colony. Robson (personal communication) observes that the species has only limited weedy tendencies in Europe. At present, the Minnesota occurrence may be regarded as a persistence after cultivation, with possible colony expansion by asexual reproduction.

Diagnostic characters. Hypericum maculatum subsp. *obtusiusculum* is distinguished from similar *Hypericum* species by the combination of its relative paucity of punctiform glands across most of the leaf blade (but present near the margins), its inflorescence branches frequently departing from the central axis at 45° or more, erose to denticulate rounded sepal apices, and petal laminar glands in long black streaks or black lines (Robson 2002).

Specimen citations. Minnesota. St. Louis Co.: NE side of Keene Creek, Duluth, SE¼ Sec. 12, T49N R15W, in fruit, 16 Sep 2007, *Schimpf 451* (BM, DUL, MIN), in flower, 27 Jul 2008, *Schimpf 494* (BM, DUL, MIN); both collections determined by Norman K. B. Robson, October 2008.

Cephalaria gigantea (Ledebour) Bobrov. (Dipsacaceae). Tatarian cephalaria.

Previous knowledge. Cephalaria gigantea is a tall perennial forb that is native to the Caucasus Mountains (Bobrov 1957). It is cultivated in North America as an ornamental (Brickell and Zuk 1996). USDA (2009) indicated that it is known outside of cultivation in North America only from Wisconsin, Ontario, and Quebec, with the Wisconsin population located at Oshkosh (Wisflora 2009).

Significance. A collection of *C. gigantea* from Duluth, Minnesota made in 1944 by Olga Lakela appears to be the first known outside of cultivation in Min-

nesota, and to represent one of only two sites in the United States. Lakela labeled this material as *Cephalaria alpina* Schrad., from a large colony in a vacant lot, with plants over 10 feet tall. She did not include this taxon in her floristic compendium (Lakela 1965), and this collection seems not to have been otherwise reported. The area from which the collection was made has become one of single-family homes and young poplar-dominated woods. A visit to the area in 2007 found no plants of this species, but trespassing considerations limited the scope of the search. The population may be extirpated.

Diagnostic characters. Cephalaria gigantea may be distinguished from *C. alpina* (Ferguson 1976) by the ovate to triangular, obtuse involucral bracts of the former (vs. triangular to lanceolate, acute), its acuminate (vs. spinescent) receptacular scales, and nearly equal length of the teeth on its epicalyx (vs. alternating long and short teeth).

Specimen citation. Minnesota. St. Louis Co.: Duluth, NE¼ Sec. 13, T50N R14W, in flower and fruit, 7 Sep 1944, *O. Lakela 5879* (DUL); determined by David Schimpf, March 2008.

Lamiastrum galeobdolon (L.) Ehrendorfer & Polatschek. (Lamiaceae). Yellow archangel.

Previous knowledge. Lamiastrum galeobdolon is a perennial forb that is native to Europe (Ball 1972a) and grown ornamentally in North America (Brickell and Zuk 1996). It is sometimes included within *Lamium*. A subset of the species is stoloniferous (Ball 1972a), and most of the horticultural forms have variegated leaves. It was reported by USDA (2009) as escaped in North America for five states, all outside of the Midwest, and by Reznicek and Simpson (2009) for northwestern and southeastern Lower Michigan.

Significance. This is apparently the first report of *Lamiastrum galeobdolon* from outside of cultivation in Minnesota. The plants were in a deciduous woods near single-family homes, where they may have established from garden discards dumped on the site. The approximately 10 plants occupied about 2 m^2, all in very deep deciduous shade on stony, sandy loam with moderate drainage. Asexual reproduction was evident; the non-flowering ramets had a maroon undersurface on each leaf blade, while the flowering ramets had green undersurfaces. It is not known whether reproduction by seed had occurred. Brickell and Zuk (1996) labeled it "very invasive", but this may refer to its local asexual behavior in gardens rather than a propensity to establish at a distance by seed.

Specimen citation. Minnesota. St. Louis Co.: Duluth, SW¼ Sec. 15, T50N R14W, in flower, 10 Jun 2008, *Schimpf 472* (DUL, MIN).

Lamium maculatum L. (Lamiaceae). Spotted deadnettle.

Previous knowledge. Lamium maculatum is a perennial forb native to Europe (Ball 1972b). It was introduced to North America for ornamental garden use, and is now documented outside of cultivation in many states and provinces east of the Mississippi River, as well as in the Pacific Northwest states (USDA 2009).

Horticultural material often has variegated leaves. The trailing stems root at the nodes (Hitchcock and Cronquist 1973).

Significance. A collection of *Lamium maculatum* in rural northeastern Minnesota seems to be the first reported outside of cultivation for the state. The plants were growing just beyond the fence of a cemetery, presumably originating from discarded grave decorations. The plants appeared to be persisting, perhaps spreading, in dense shade of *Abies balsamea* and *Picea glauca*.

Specimen citation. Minnesota. St. Louis Co.: Palo, SW¼ SE¼ Sec. 18, T57N R15W, 31 Oct 2007, *Pomroy, Schimpf and R. Barnes 2487* (DUL, MIN).

Spiraea ×*billiardii* Hérincq. (Rosaceae). Billiard's spiraea.

Previous knowledge. Spiraea ×*billiardii* is a deciduous shrub that was created in horticulture by crossing the North American *Spiraea douglasii* Hook. with the Eurasian *Spiraea salicifolia* L. (Bailey 1949). It has been reported from outside of cultivation in North America in several Middle Atlantic states and Arkansas (USDA 2009).

Significance. Spiraea ×*billiardii* was found outside of cultivation in Duluth, Minnesota, the apparent first report for the north-central United States. The shrubs dominated a strip about 6 m long by 1 m wide in a brushy power line corridor near a residential neighborhood. They were up to 2 m tall, perhaps spreading by suckers, as the parent species are known to do (Rehder 1960).

Diagnostic characters. Spiraea ×*billiardii* is separable from *S. salicifolia* by the glabrous leaves of the latter, and from *S. douglasii* by the tomentose and obtuse leaves of this parent (Rehder 1960).

Specimen citation. Minnesota. St. Louis Co.: Duluth, SW¼ Sec. 15, T50N R14W, in flower, 26 Jul 2008, *Schimpf 493* (DUL, MIN).

Impatiens glandulifera Royle. (Balsaminaceae). Ornamental jewelweed.

Previous knowledge. Impatiens glandulifera is a tall forb native to the Himalaya Mountains (Vivekananthan et al. 1997), introduced to North America for ornamental use (Bailey 1949). It has been reported from outside of cultivation in many Canadian provinces and northern states, but not in the north-central states (USDA 2009). State governments in Connecticut, Oregon, and Washington designate it as invasive (USDA 2009). Gleason and Cronquist (1991) and Moore (1968) listed it as an annual, but Vivekananthan et al. (1997) described it as a perennial.

Significance. A collection of *Impatiens glandulifera* at a rural wayside rest stop seems to be the first reported from outside of cultivation in Minnesota. A single plant was growing near a parking area in mixed coniferous/deciduous shade. This is far away from the nearest residence, so probably is not an escape from local cultivation. The collector also observed one plant of this species in seemingly the same spot in 2007.

Specimen citation. Minnesota. Lake Co.: Caribou River, SW¼ NE¼ Sec. 36, T58N R6W, in flower, 30 Aug 2008, *Green s.n.* (DUL).

Malva moschata L. (Malvaceae). Musk mallow.

Previous knowledge. Malva moschata is a perennial forb native to much of Europe and naturalized from flower gardens in the remainder of it (Dalby 1968). Introduced to North America as a garden ornamental (Bailey 1949), it is known outside of cultivation in much of northeastern and northwestern North America (USDA 2009).

Significance. A population of *M. moschata* in a lawn is apparently the first to be reported from outside of cultivation in Minnesota. About 10 plants were flowering, scattered across a residential lawn that had gone without mowing for weeks. The site was a sunny, SE-facing slope, which was very dry at the time of collection because of a drought. The *Malva* plants showed no deleterious effects from this drought.

Specimen citation. Minnesota. St. Louis Co.: Duluth, NE¼ Sec. 15, T50N R14W, 18 Aug 2007, *Schimpf 435* (DUL, MIN).

Euonymus alatus (Thunberg) Siebold. (Celastraceae). Winged burning bush.

Previous knowledge. Euonymus alatus is a deciduous shrub that is native to most of eastern Asia (Ma and Funston 2008). It is cultivated in North America (Bailey 1949) for its colorful autumnal foliage and distinctive winged twigs. It has been reported growing outside of cultivation in most eastern states of the United States (USDA 2009). State governments in Connecticut and Massachusetts designate it as invasive (USDA 2009).

Significance. Two juvenile plants of *E. alatus* were found growing in considerable deciduous shade, apparently the first report from outside of cultivation in Minnesota. These were in well-drained loam where the vegetation was not maintained. One plants was 1 m tall, the other 0.35 m. They were about 2 m away from two large fruiting plants that had evidently been planted in this public park; the specimens cited are from one of these fruiting shrubs. Because *E. alatus* is not reported to reproduce asexually at this distance, the smaller plants likely originated from seeds produced by one or both of the adults.

Specimen citation. Minnesota. St. Louis Co.: NE side of Keene Creek, Duluth, SE¼ Sec. 12, T49N R15W, 15 Sep 2007, *Schimpf 449* (DUL, MIN).

Myosotis sylvatica Hoffmann. (Boraginaceae). Woodland forget-me-not.

Previous knowledge. Myosotis sylvatica is a perennial forb native to much of Europe (Grau and Merxmüller 1972). This species was introduced to North America for use in flower gardens (Bailey 1949), and is escaped or naturalized in most provinces of Canada and northern states of the U. S. (USDA 2009). The apparently sole herbarium record for Minnesota is a collection from near cabins in Lake Itasca State Park in 1965 (Bell Museum Herbarium 2009).

Significance. Two collections of *Myosotis sylvatica* were made from robust local populations in forest remnants near residential neighborhoods in Duluth, Minnesota, suggesting that this species has potential to become extensively naturalized in the area. The collection sites were dominated by mature *Acer sac-*

charum and other northern hardwoods on stony sandy loam. Although these *M. sylvatica* populations are near footpaths, the species appears to be spreading farther. Blue-flowered plants were more common than white-flowered plants. In addition to the collection localities, we observed *M. sylvatica* in other Duluth forest remnants.

Specimen citations. Minnesota. St. Louis Co.: Duluth, NE¼ NE¼ Sec. 15, T50N R14W, 31 May 2008, flowers blue, *Schimpf 467* (DUL, MIN), flowers white, *Schimpf 468* (DUL, MIN); Duluth, SW¼ Sec. 15, T50N R14W, 1 June 2008, flowers blue, *Schimpf 469* (DUL, MIN), flowers white, *Schimpf 470* (DUL, MIN).

Papaver rhoeas L. (Papaveraceae). Corn poppy.

Previous knowledge. Papaver rhoeas is an annual forb, native to Europe, southwestern Asia, and northern Africa; in North America it is escaped from ornamental cultivation to disturbed ground or introduced as a contaminant of crop seed (Kiger and Murray 1997). A 1958 collection from the western border of Minnesota is apparently the only record from outside of cultivation in the state (Bell Museum Herbarium 2009).

Significance. A population in disturbed waste ground of an industrial area in Duluth, Minnesota, is apparently the second known outside of cultivation for the state. The plants were growing in full sun in sandy, well-drained soil with other alien species. Among these associates were *Papaver somniferum* L., which has been collected from outside of cultivation at two other Duluth locations but nowhere else in the state. All of the *P. rhoeas* collections were in flower.

Specimen citations. Minnesota. St. Louis Co.: Duluth, NW¼ Sec. 8, T49N R14W, 10 Jul 2008, *Pomroy and R. Barnes 2520* (DUL, MIN), 12 Jul 2008, *Pomroy and R. Barnes 2527* (DUL), 6 Aug 2008, *Pomroy and R. Barnes 2582* (DUL, MIN); all collections determined by David Schimpf, September 2008.

Centaurium pulchellum (Swartz) Druce. (Gentianaceae). Branched centaury.

Previous knowledge. Centaurium pulchellum is a small annual forb native to most of Europe (Melderis 1972). It has spread to many places in central and eastern North America as a weed (USDA 2009). In Minnesota, the only previously reported collection is from a pasture in one south-central county in 1972 (Bell Museum Herbarium 2009).

Significance. Collections made from two widely separated places near Lake Superior in northeastern Minnesota greatly extend the known range within the state. The Cook County plants were in a wetland mitigation site, and the St. Louis County plants were along a puddle near a railroad. Several collections from Douglas County, Wisconsin had been made not far from the St. Louis County site (Wisflora 2009, plus see below).

Specimen citations. Minnesota. Cook Co.: Taconite Harbor, S½ NW¼ Sec. 3, T58N R5W, 15 Aug 2008, *Pomroy, R. Barnes and K. Samuelson 2614* (DUL, MIN); St. Louis Co.: Duluth, SE¼ Sec. 3, T49N R14W, 12 Sep 1994, *G. Walton 1568, 1570* (DUL). Wisconsin. Douglas Co.: Superior, NW¼ Sec. 25, T49N

R14W, 23 Aug 1995, *G. Walton 1846* (DUL), 4 Sep 1995, *G. Walton 1894* (DUL).

Tanacetum parthenium (L.) Schultz-Bipontinus. (Asteraceae). Feverfew.

Previous knowledge. Tanacetum parthenium is a perennial forb native to Eurasia and North Africa (Watson 2006). It was introduced to North America for both ornamental (Brickell and Zuk 1996) and medicinal (van Wyk and Wink 2004) cultivation, and is naturalized over much of the continent (USDA 2009). In Minnesota a 1993 collection from the edge of a woods in a southeastern county is apparently the only place in the state that it has been discovered outside of cultivation (Bell Museum Herbarium 2009).

Significance. A collection from Duluth, Minnesota represents a substantial range extension for *T. parthenium* in the state. Some of the plants were growing beneath considerable shade from second-growth deciduous woods, scattered over a few tens of meters, mostly near footpaths. The species most likely escaped from a nearby residential neighborhood. The soil was fairly well-drained stony sandy loam.

Specimen citation. Minnesota. St. Louis Co.: Duluth, SW¼ Sec. 15, T50N R14W, in flower, 9 Jul 2008, *Schimpf 475* (DUL, MIN).

WISCONSIN

Avenula pubescens (Hudson) Dumort. subsp. *pubescens.* (Poaceae). Downy alpine oatgrass.

Previous knowledge. Avenula pubescens subsp. *pubescens* is a loosely tufted perennial grass native to Europe, Siberia and central Asia (Dixon 1991). *Avenula* has often been included within *Helictotrichon*, from which it differs in a number of characters (Tucker 2007). Across most of Europe *A. pubescens* is a common inhabitant of grasslands and open woods, as well as gravel pits, roadsides, and railway banks (Dixon 1991). Along the European coast it inhabits cliffs, stony sea-slopes and stabilized dunes, and has been recorded from salt marshes (Dixon 1991). It usually inhabits moist to fairly dry, well-drained soils, but can survive and reproduce on wet soils (Dixon 1991). In North America USDA (2009) indicates *A. pubescens* occurrences in Canada from Quebec west to Alberta, in four New England states, New Jersey, Delaware, and Minnesota. The Minnesota report appears to be based on an error in Gleason and Cronquist (1991), who may have confused this alien with the native *Avenula hookeri* (Scribn.) Holub. Gleason and Cronquist (1991) inexplicably omitted *A. hookeri*, long known in northwestern Minnesota at the eastern edge of its range (Tucker 2007), but listed western Minnesota as the only part of the state occupied by *A. pubescens*. No herbarium collections of *A. pubescens* from the Minnesota wild are known at MIN (Bell Museum Herbarium 2009) or DUL.

Avenula pubescens is a variable species, encompassing a dozen previously named species and over 50 infraspecific taxa (Röser 1995). Two subspecies of *A.*

pubescens are generally recognized. Subspecies *laevigata* (Schur) Holub is restricted to the Alps and Carpathians, while subsp. *pubescens* is found throughout the native range of the species (Dixon 1991).

Significance. Two populations near the town of Glidden, Wisconsin apparently represent the first reported for *Avenula pubescens* outside of cultivation in the U. S. other than in the northeastern states. A colony of roughly 20 flowering plants and a similar number of nonflowering clumps were found on disturbed, gravelly ground in an old field north of town, just east of State Highway 13. Scattered patches were also found south of town; here *A. pubescens* was a dominant herb along the east side of a mesic young *Pinus resinosa* plantation, comprising much of the ground cover over an area of at least 0.4 ha. Competing vegetation consisted mostly of *Danthonia spicata* (L.) P. Beauv. ex Roem. & Schult. (poverty oatgrass) and other native species.

Diagnostic characters. Avenula pubescens superficially resembles *D. spicata*, which may have allowed the apparently long-established *A. pubescens* to escape detection. Upon closer inspection the two are easily distinguished (Gleason and Cronquist 1991; Tucker 2007). *Avenula pubescens* is shortly stoloniferous, forming loosely rather than densely cespitose clumps like *D. spicata*. The sheaths of alpine oatgrass are evidently hairy, while (except for the characteristic tuft of hairs at the summit of the sheath) those of *D. spicata* are usually sparsely pilose or glabrous. The leaves of *A. pubescens* are relatively thick and flat, with blades usually pilose and 2-6 mm or more wide, while those of *D. spicata* are thin, often curled and involute, about half as wide, and usually glabrous. The lemmas of *A. pubescens* are scabrous, while those of *D. spicata* are usually sparsely pilose on the back. The geniculate awns on the lemmas of *A. pubescens* arise from the back of the distally erose lemma, rather than from the apex of the lemma between two small teeth (to 1.8 mm long) as in *D. spicata*. Unlike *D. spicata*, both the callus and rachilla of *A. pubescens* are pilose, giving the florets (with persistent rachilla) a distinctive "two-tufted" appearance (see photograph of *A. pubescens* at USDA 2009). *Avenula pubescens* does not produce cleistogamous flowers and is an obligate outcrosser (Dixon 1991), while *D. spicata* often produces cleistogamous spikelets within the lower sheaths and apomictic seed (Gleason and Cronquist 1991). Finally, *A. pubescens* is a somewhat larger, taller plant than *D. spicata* overall, with florets approximately twice as long as those of *D. spicata* (Gleason and Cronquist 1991; personal observation). With its more colorful, purple-tinged stems, wider, flat leaf blades, and somewhat larger average size (Gleason and Cronquist 1991), *Danthonia compressa* Austin might also be confused with *A. pubescens*. This uncommon species is otherwise very similar to *D. spicata*, but with the lemma teeth 2–3 mm long (Gleason and Cronquist 1991). The primary morphological difference between the two subspecies of *A. pubescens* is that subsp. *laevigata* has spikelets 15–26 mm long with 3–4 florets, vs. 10–17 mm long with 2–3 florets for subsp. *pubescens* (Tucker 2007).

Specimen citations. Wisconsin. Ashland Co.: Jacobs Township, SE¼ SW¼ Sec. 2, T42N R02W, 8 Jul 2008, *Garske 709* (DUL, OSH, UWSP, WIS); Jacobs Township, NW¼ NW¼ Sec. 13, T42N R02W, 30 Jul 2008, *Garske 721* (UWSP, WIS).

Rumex thyrsiflorus Fingerhuth. (Polygonaceae). Narrow-leaved sorrel.

Previous knowledge. Rumex thyrsiflorus is a dioecious perennial forb native from central and eastern Europe to southern Siberia (Mosyakin 2005). In Europe it inhabits meadows, waste places, roadsides, wood edges and upper floodplains (Nabben et al. 1999; Mosyakin 2005). It was first collected in North America in a field in Ontario in 1871, then several times in the early 1900s from Quebec and Ontario. The first U. S. collection was from "waste ground near the docks in St. Ignace" in Michigan in 1948 (Voss 1985). In each case the species was misidentified as *Rumex acetosa* L. Not until 1957 was the occurrence of *R. thyrsiflorus* in North America recognized (Löve and Löve 1957). Narrow-leaved sorrel has been reported in Canada from Nova Scotia to Saskatchewan (USDA 2009). It is also known from Emmet, Mackinac and Keweenaw counties in Michigan (Reznicek and Simpson 2009).

Significance. This large, presumably long-established population apparently represents the first report of this species from Wisconsin and the only one in the U. S. outside of Michigan. The species was locally abundant along several miles of roadside and on adjacent power corridors and old fields a few km northeast of the village of Patzau, in full sun to partial shade. Collections were from a dry, gravelly, compacted road shoulder (where the plants were flowering after being mowed several weeks earlier) and from a mesic, heavily-vegetated power-line corridor that had escaped mowing that summer. The local abundance of this species strongly suggests that it is well adapted to disturbed habitats in the upper Great Lakes region.

Diagnostic characters. Although *Rumex thyrsiflorus* has been considered by a few authors to be a variety or subspecies of *Rumex acetosa*, it differs from *R. acetosa* in a number of major ways, most notably in having a stout, vertical rootstock, relatively long, narrow leaves (illustrated in Mosyakin 2005) and a dense, highly branched, narrowly pyramidal thyrse (Figure 1), as opposed to *R. acetosa*'s narrower roots, shorter and relatively wide leaves, and cylindric, once- or twice-branched inflorescence (Mosyakin 2005). Voss (1985) contrasts the tepals, with those of *R. thyrsiflorus* bright pink vs. green to pinkish for *R. acetosa*. Laboratory

FIGURE 1. The narrowly pyramidal, repeatedly branched thyrse of *Rumex thyrsiflorus*. Douglas County, Wisconsin, October 31, 2008, after all floral appendages had fallen (Photo by Steve Garske).

hybrids between the two species from the native range are less vigorous than the parent plants and have low fertility (Świetlińska et al. 1971).

Specimen citations. Wisconsin. Douglas Co.: SE¼ SW¼ Sec. 32, T47N R14W, 22 Aug 2008, *Garske 727* (DUL, OSH, UWSP, WIS); SW¼ NE¼ Sec. 31, T47N R14W, 26 Aug 2008, *Garske 728* (OSH, UWSP, WIS).

Leontodon autumnalis L. (Asteraceae). Fall dandelion.

Previous knowledge. Leontodon autumnalis is a perennial forb that is native to Eurasia (Bogler 2006). It is naturalized in parts of northeastern and northwestern North America (USDA 2009). In Wisconsin, it was first collected in Sheboygan County in 1903, but apparently no other place in the state for approximately a century (Wisflora 2009).

Significance. Recent collections from Douglas County suggest that *L. autumnalis* is firmly established in extreme northwestern Wisconsin. The populations were on roadsides or maintained turf at several widely separated sites. In addition, this species is very abundant across the St. Louis River in Duluth, Minnesota, which is probably a persistent source of seeds for the region. All of the populations were in both flower and fruit when collected.

Diagnostic characters. The rosette of leaves of *L. autumnalis* somewhat resembles that of the common dandelion *Taraxacum officinale* Wiggers. *Leontodon autumnalis* may be distinguished by its fibrous roots, branched scape, somewhat smaller heads, failure to flower early in the growing season, beakless achenes, and plumose pappus bristles (Gleason and Cronquist 1991).

Specimen citations. Wisconsin. Douglas Co.: Oliver, NW¼ Sec. 12, T48N R15W, 12 Sep 1999, *Schimpf 278* (DUL); Superior, SE¼ Sec. 3, T48N R14W, 24 Aug 2007, *Schimpf 438* (DUL, WIS); Superior, NW¼ Sec. 21, T49N R14W, 1 Sep 2007, *Schimpf 446* (DUL, WIS); Superior, NE¼ Sec. 30, T49N R13W, 12 Oct 2007, *Schimpf 457* (DUL, WIS).

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IN MEMORIAM – JOHN W. THOMSON

Theodore S. Cochrane

Dr. John W. Thomson, Professor of Botany Emeritus, dean of American lichenologists, and founder of the Botanical Club of Wisconsin, passed away on February 20 at his rural Mt. Horeb home. He was 95 years old.

Thomson was born in Cockenzie, Scotland, in 1913 but immigrated to France and then to the United States while still a child. He graduated from Columbia University in 1935, where he majored in botany and zoology, and earned his master's and doctoral degrees from the University of Wisconsin in 1937 and 1939, respectively. He studied the ecology of prairie plants in central Wisconsin for his dissertation. As a graduate student in botany, in the company of dedicated professors, particularly Norman C. Fassett, his major professor, and ecologists and environmentalists John T. Curtis and Aldo Leopold, Thomson's affinity for the life of a scientist was only reinforced. Conscientious, careful, and organized, it seemed natural he would be drawn to ecological and taxonomic studies. After finishing graduate school, he worked in New York as a naturalist at the American Museum of Natural History and taught at Brooklyn College before returning to Wisconsin to take a position at Superior State Teachers College (now the University of Wisconsin-Superior) in 1942, where he served for two years before joining the faculty of the Department of Botany at the University of Wisconsin-Madison in 1944. He retired in 1984 but continued to come to school and work almost daily until about 2001.

At the University of Wisconsin Thomson was professor of botany. His research dealt with the identification and classification of lichens, those unique, plant-like, symbiotic organisms composed of a fungal partner, the mycobiont, and one or more photosynthetic partners, the photobiont(s). Although he never lost interest in the higher plants, Thomson's involvement with lichens began in 1935 and developed rapidly; he spent the rest of his life building up his knowledge of the lichens of North America. From the mid 1950s onward he focused on the American boreal and arctic lichens, starting with the Hudson Bay region and the Canadian Eastern Arctic, then extending his studies westward across the continent. Thomson was the first person to systematically collect, identify, and map the lichen flora of the tundra regions of northern Canada and Alaska. He made 14 expeditions to the American Arctic, collecting lichens across the vast expanse of terrain from Labrador to the Arctic islands to the Bering Straits. By 1978 Thomson estimated he had identified 90,000 lichen specimens from the North American tundra using chemical tests and thin-layer chromatography. Needless to say, his collections and those of his students form a significant part of the University of Wisconsin Lichen Herbarium.

Thomson was a scientist/professor of the old school, broadly trained with a big outlook, cultured, zealous in his campus duties, always neat in appearance, always courteous and helpful to visitors. His varied interests included cryptogamic botany, plant taxonomy, science education, conservation, dendrology, ethnobotany, ecology, horticulture, phenology, and geology. Thomson's main interests may have been in science and the university, but he and wife Olive became citizens of Wisconsin as well as the university. Both were joiners and doers; they set down deep community roots, incessantly performing services and attending meetings, often traveling all over the state.

Thomson lectured widely and published a large number of monographs, revisions, papers, and five books, including *Lichens of the Alaskan Arctic Slope* (1979), *American Arc-*

JOHN W. THOMSON
(Photo by C. Lipke, UW-Botany)

tic Lichens. 1. The Macrolichens (1984), and *American Arctic Lichens. 2. The Microlichens* (1997). In 1995 *American Arctic Lichens*, vol. 1, won the 1985 Gleason Award, presented by the New York Botanical Garden each year to an outstanding publication in plant taxonomy. In 2003, at the age of 89, he published *Lichens of Wisconsin*, a guide to the 660 species of lichens growing across the state. He wrote many floristic papers, including reports on the lichens collected on the yearly forays of the American Bryological and Lichenological Society (ABLS). Thomson also wrote more general articles on the structure, habits, and uses of lichens.

In 1985 John and Olive Thomson won the Gulf Oil Conservation Award, and in 2005 John was one of the first to receive the Acharius Medal from the International Association of Lichenology, a major award specifically for work on lichens. The prize selection committee cited Thomson's pioneering studies and body of work, which embody the highest standards of scholarship and have profoundly influenced generations of lichenologists.

Dr. Thomson's achievements as a scientist are especially impressive when one remembers that through all those years he was carrying a full teaching load. A teacher and conservationist all his life, Thomson's popular courses in plant taxonomy and dendrology have influenced two generations of students in biology and conservation, many of whom became professional botanists, horticulturalists, conservationists, rangers, or naturalists, as well as hundreds who volunteer their time and resources to organizations involved in natural area preservation. He was always happy to share his knowledge with amateurs and professionals alike and was ever willing to lead field trips for local groups. He spent seven decades as an active participant in and leader of organizations like the Wisconsin Academy of Sciences, Arts and Letters (WASAL; President; founder and President of the Junior Academy of Science for 16 years), The Nature Conservancy (TNC; Board of Trustees for the Wisconsin Chapter), Citizens Natural Resources Association of Wisconsin (CNRA), American Bryological and Lichenological Society (ABLS; Vice-President; President), The Torrey Botanical Club (TBC; Recording Secretary), The Prairie Enthusiasts (TPE), and the Botanical Club of Wisconsin (BCW; Academy Representative). He served on the boards of the UW Arboretum and UW-Extension's Camp Upham Woods and the advisory committee of the Lake Itasca Biological Station for many years.

It was while he was President of WASAL that Thomson instigated the founding of the BCW. Having been involved in the TBC of New York, Thomson believed that a similar organization, especially one that included field trips, would be influential in encouraging Wisconsin citizens to appreciate botany. He appointed a committee chairman, Dr. James H. Zimmerman, who issued an invitation to interested persons to meet for the purpose of discussing the proposed organization. On April 6, 1968, the first meeting was held in the Thomson home, and soon thereafter the academy issued an invitation to all its members to join the newly formed BCW, which was established as an affiliate of WASAL.

Thomson is survived by his wife of nearly 72 years, Olive; sons Dennis, Norman, and Roderic and their wives and children; and daughter Elizabeth and her husband. A son, Douglas, and two sisters predeceased him. His family suggests that friends wishing to honor John should consider a remembrance donation to an organization dedicated to wildlife or environmental protection or to the University of Wisconsin-Madison Herbarium, where John worked for so many years (see instructions under the link "Support" on the Wisconsin Vascular Plants web site: http://www.botany.wisc.edu/wisflora).

BOOK REVIEWS

Petty, R. O. and Anne M. Petty. 2005. Wild Plants in Flower—*Wetlands and Quiet Waters of the Midwest.* Quarry Books an Imprint of Indiana University Press, Bloomington, IN, 99 pp. ISBN-0-253-21766-0. $14.95

This small book of 4 × 6 inch size was first written and originally planned to be the first of a five part series on plants called *Wild Plants in Flower*, which never materialized.

The book includes eight short chapters in four colors and traces a quiet journey across the vanishing wetlands that make up only 6% of the land found in the Midwest. On one page is found special running thoughts about what is viewed as one looks across lakes, swamps, ponds, floodplains and marshes, and a description of species. On the other facing page in vivid color is an image of one of the forty-five species described in the book. The authors engage each plant species for its habitat, appearance, range and dangers faced. It is a brief field guide to enhance the users appreciation of this dwindling ecosystem.

The book would make a fine gift to a friend who enjoys the out of doors and who appreciates the natural world. I know, because a friend gave me my copy.

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Mabberley, D. J. 2008. *Mabberley's Plant-book*, Third Edition. Cambridge University Press, New York, 1019 p. ISBN 978-0-521-82071-4

This is the third edition of what originally was in the first two editions named *The Plant-book*. The original editions of this dictionary were updated dictionaries and replacements for the standard tool for botanical information J. C. Willis's, *Dictionary of the Flowering Plants and Ferns*. This "*Plant-book" has* become the internationally recognized guide completely rewritten to over 24,000 entries and over 1650 new items for anyone wanting information on every family and genus of vascular plants. This new edition documents taxonomic and morphologic information based on vernacular, Latin and English names arranged alphabetically. The non-professional plant lover will like the many new included vernacular names, which are found in the timber trade and used commercially. This third edition updates each entry based on the most recent experimental, ecological and molecular literature.

In the earlier editions the author followed the classification system of Cronquist, *An Integrated System of Classification of Flowering Plants*. In the present volume the author follows Kubitzki's, *The Families and Genera of Vascular*

Plants and incorporates new views from the Angiosperm Phylogeny Group (APG) as summarized on the web at: <http://www.mobot.org/MOBOT/Research/APweb/welcome.html>.

The amount of information recorded in this book would normally be found in many volumes but Mabberly has condensed and compiled voluminous material in 1000+ pages and in an approximate handbook size of 5 × 9 inches (12.5 × 23 cm) and under 1¾ (4.5 cm) inches thick. Like its predecessors this book is a real plant pocket book small enough to fit in any small space. Every herbarium large or small should have a copy for everyone to use. This tome is a must for any serious student's botany reference book collection.

When the telephone in my office rings and the caller is seeking taxonomic information on vascular plants, the majority of the time I can find the information in this book. It is one book I cannot be without!

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INSTRUCTIONS TO AUTHORS

1. Create text in 12-point Times New Roman font and double space paragraphs throughout. Papers should be organized as follows: Title, Author(s) and address(es), Abstract with up to 5 keywords, Introduction, Materials and Methods, Results, Discussion, Acknowledgements, Literature Cited, Tables, Figure Legends, and Figures. Sections may be omitted if not relevant. All pages should be numbered. Please contact the editor regarding any questions related to formatting.

2. For noteworthy collections, manuscripts should be formatted as described in *The Michigan Botanist*, volume 27(3) p. 90. A brief description of the formatting follows. The following title, "Noteworthy collections", should begin each submitted manuscript followed on the next line by the State or Province for the species reported. The next line should list the taxon of interest using the following format: *Species* Author(s) (Family). Common name. The rest of the manuscript should include the following named sections: Previous knowledge, Significance of the report, Diagnostic characters (if desired), Specimen citations, and Literature cited. Each of these sections are largely self explanatory; however, "specimen citations" should include the relevant label data from the voucher specimen(s) including location data, collector(s), collection number, etc. Also please include which herbarium the specimen(s) is deposited in using the Index Herbariorum acronym. The manuscript should end with the name and address of the author(s).

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8. Italicize all scientific names. Voucher specimens must be cited for floristic works or any other relevant study. Papers citing plant records without documenting vouchers are generally not acceptable.

9. Manuscripts may be submitted electronically to the email address of the editor. Printed versions of manuscripts may also be submitted in which case three copies should be provided. All manuscripts will be reviewed by at least two referees. A more complete set of instructions is available at http://www.michbot.org/publications/Botanist/instruct_authors.htm.

CONTENTS

The Green Alga *Askenasyella* (Tetrasporales) in Michigan
Daniel E. Wujek 33

Demystifying Nomenclature: The Game of the Name
Edward G. Voss 38

Noteworthy Collection
Richard L. Gardner, Thomas P. Arbour, and Daniel Boone 45

Noteworthy Collection
John G. Zaborsky 47

Noteworthy Collection
David J. Schimpf, Deborah L. Pomroy, Steven C. Garske, and John C. Green 49

In Memoriam—John W. Thomson
Theodore S. Cochrane 61

Book Reviews 63

On the cover: Avenula pubescens *subsp.* pubescens *inflorescences at anthesis. Ashland County, Wisconsin, June 19, 2009 (Photo by Steve Garske).*

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Membership is open to anyone interested in its aims: conservation of all native plants; education of the public to appreciate and preserve plant life; sponsorship of research and publication on the plant life of the state and the Great Lakes area in general, both in the USA and in Canada; sponsorship of legislation to promote the preservation of Michigan's native flora; establishment of suitable sanctuaries and natural areas, and cooperation in programs concerned with the wise use and conservation of all natural resources and scenic features.

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THROUGHFALL PH IN A MIXED DECIDUOUS-CONIFEROUS FOREST, ONTARIO, CANADA: THE EFFECT OF OVERSTORY SPECIES COMPOSITION

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ABSTRACT

Throughfall and precipitation pH were observed for one growing season in an undisturbed mixed deciduous-conifer forest on the east shore of Lake Superior in Ontario. Rainfall and throughfall were collected for pH analysis from late-May through mid-August under the dominant tree species. From a total of 18 measureable rainfall events, pH of deciduous (sugar maple and paper birch) and coniferous (white spruce and balsam fir) throughfall was significantly less acidic than the incident rainfall for nine of the events; particularly for events following deciduous canopy leafout. Deciduous and coniferous throughfall pH differed significantly from each other for four of the 18 rain events throughout the middle of the growing season. Paper birch had the least acidic throughfall and sugar maple, white spruce, and balsam fir throughfall were generally similar and more acidic. The spatial heterogeneity of throughfall chemistry as controlled by overstory species composition, in addition to numerous other environmental factors that differ at fine spatial scales in forest understories, may play an important role in mediating germination, growth rates, carbon assimilation rates, and mortality of understory tree seedlings.

Keywords: *Acer saccharum*, deciduous forest, coniferous forest, throughfall, soil pH

INTRODUCTION

Understory environmental conditions play an important role in mediating a wide array of ecological processes. A large body of ecological research has focused on how light, edaphic conditions, temperature, relative humidity and a long list of other physical factors control biodiversity, growth rates, mortality rates, and regeneration. These and other environmental variables exert a strong influence on understory plant communities (Barbier et al. 2008).

In some ecosystems, atmospheric deposition of acidic compounds has been identified as contributing to forest decline (Shibata and Sakuma 1996) as base cations are leached from the soil (Shibata et al. 1995). This is the case for large areas of the forests of Ontario, Canada including the forests on the eastern shore of Lake Superior (Morrison et al. 1992, Morrison 2004) as the soils in these forests lack the ability to buffer acid deposition (Morrison et al. 1992). Acid deposition in both dry and wet forms collect on leaves in the forest canopy, poten-

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tially leading to canopy exchange (washoff of deposited particles and gases) (Lovett and Lindberg 1984), which following a precipitation event may eventually drip onto the forest floor as throughfall. As a result, throughfall is frequently enriched with base cations and strong acid anions (Neary and Gizyn 1994), and may be less acidic than rainfall pH (Moore 1983).

The degree to which the forest canopy alters throughfall is dependent on the species composition of the adult tree layer (Mahendrappa 1989). In a mixed canopy forest it is possible that throughfall chemistry can be highly spatially heterogeneous (Keim et al. 2005) potentially altering water and soil resources at fine spatial scales that might favor one species over others (Wallrup et al. 2006). This project is part of a larger ongoing assessment of the degree to which canopy overstory conditions affect growth, carbon assimilation, and mortality rates of sugar maple seedlings due to varying light levels under coniferous and deciduous canopies, moisture and temperature regimes, and nutrient additions through stemflow and throughfall.

As summarized by Morris et al. (2003) a number of studies have recently explored spatial patterns of throughfall chemistry in mixed forests, but studies of temporal variability are generally lacking. Thus, for a mixed deciduous-conifer forest in central Ontario we address the following objectives: 1) does throughfall pH and rainfall pH vary significantly during the growing season and 2) to what extent does overstory species composition affect throughfall pH.

MATERIALS AND METHODS

Study Area

This research was conducted in a mixed temperate deciduous-conifer forest in Lake Superior Provincial Park (LSPP), Ontario, Canada (47°44′N, 84°49′W). The park is located at the ecotone between the temperate deciduous forest (found to the south) and boreal forest (dominant from the study area north) on the northeastern shore of Lake Superior, approximately 300–400 m above sea level (Barras and Kellman 1998; Goldblum and Rigg 2002; 2005). The forests are dominated by two coniferous species: white spruce (*Picea glauca*) and balsam fir (*Abies balsamea*); and three deciduous species: sugar maple (*Acer saccharum*), the rare yellow birch (*Betula alleghaniensis*), and paper birch (*Betula papyrifera*) (Goldblum and Rigg 2005).

On the upland hills, little soil development has occurred; therefore most of the plants growing in these areas are rooted in the surface organic material that is covering the rocky surface below (Kellman 2004). Soil pH ranges from 3.7 to 4.4 in the areas in which mineral soil is present (Goldblum and Rigg 2002).

The study site is a 1 ha area approximately 5 km south of the sugar maple northern limit in this region of Ontario. Previous stand structure analysis at the site indicated a total tree (>5 cm dbh) density of 1175 trees/ha. (Goldblum and Rigg 2002) The only tree seedlings (<30 cm ht.) and saplings (>30 cm ht, <5 cm dbh) in the study site are sugar maple with a seedling density of 29.9/m^2, and a relatively high sapling density of 10000/ha (Goldblum and Rigg 2002).

The Environment Canada weather station in Wawa, Ontario (25 km north of LSPP) maintains the closest long-term weather records to the study area (Kellman 2004; Goldblum and Rigg 2005). According to Environment Canada (2002), Wawa has a mean January temperature of –14.8 °C (std. dev. = 3.2) and a mean July temperature of 14.8 °C (std. dev. = 1.5). The annual average rainfall in Wawa is 727.4 mm, while the annual average snowfall is 328.6 cm, with the largest average snow depth occurring in February (67 cm) (Environment Canada 2002).

For comparison with the sampled forest, LSPP collects rainfall twice daily at the park headquarters (≈1 km S of the study site). Rainfall amounts were collected in the field site with a Decagon Devices ECRN-100 double-spoon tipping bucket rain gauge (resolution ±0.02 mm) and logged every 30 minutes with a Decagon Devices EM-50 data logger.

Field data collection

At the beginning of the 2008 growing season (prior to canopy leafout) we distributed 50 bulk throughfall collectors throughout the mixed deciduous-conifer forest of the study site. The understory at the fieldsite is open, and collectors were located so as not to receive throughfall from understory vegetation. We recorded the species composition of the immediate overstory for each throughfall collector into one of five mutually exclusive categories: sugar maple (n=14), white birch (n=4), balsam fir (n=7), white spruce (n=6), or partially open canopy (n=15), which were located in small gaps. The larger field objective was not only to quantify throughfall pH by overstory species, but to characterize the overall pattern of throughfall pH for the study area. This design provides ecologically meaningful information as understory plants are found throughout the understory under a variety of overstory conditions. Four throughfall collectors were ultimately excluded from analyses as they were under dead canopies or mixed canopies (which only became apparent after leaf out). Two collectors were placed outside the forest (≈ 2 km from the study site) to help quantify precipitation pH.

Following each measureable (> 1 mm) precipitation event, we collected water from the bulk collectors and measured pH in the field with an Oakton 310 Series pH Meter, and rinsed the collector with distilled water. The pH meter was calibrated twice during each set of field measurements. In the few cases where foreign biological material (e.g. leaves, slugs, insects) was found in the collector, no measurement was taken.

Standard statistical tests were used to address the scientific objectives. Tests used included: one-sample t-test, unpaired t-test, Spearman rank correlation, ANOVA, and Kruskal-Wallis. In the event that an ANOVA test identified a significant difference, we performed a post-hoc Tukey test. Given the risk of committing a Type I statistical error, all tests were conducted with a significance threshold of at least $p<0.01$.

RESULTS

During the 2008 growing season (May 25–August 15) there were 18 distinct measureable rain events distributed evenly throughout the summer (Table 1). Rainfall amounts measured in the field site and at the park headquarters were highly correlated (Spearman rank correlation; $r = 0.86$; $p<0.0001$); thus, rain amounts reported below are from the rain gauge in the field site. The mean rainfall event during the study period was 8.54 mm, but events were highly variable (SD = 8.78 mm). Individual precipitation events ranged from 1.27–32.51 mm. Total measured rainfall was 153.67 mm. We were able to collect rainfall samples for pH analysis outside of the forest, for 11 of the 18 events (in general, we were unable to collect an adequate sample for the smaller rain totals to perform field-based pH testing).

Overall, average rainfall pH measured outside the forest during the study period was 4.85 (SD = 0.50), with the most acidic event (June 13) being 3.71 (coinciding with the largest rain event; 32.51 mm) and the least acidic event (June 10) being 5.56 (coinciding with a 5.33 mm event). Average overall throughfall pH measured in the forest during the study period was 5.25 (SD = 0.61), with the most acidic event (May 31) being 4.22 and the least acidic event (June 26) being 6.12. There were significant differences (one-sample t test; $p<0.01$) between precipitation pH (measured outside the forest) and forest canopy throughfall (both deciduous throughfall and coniferous throughfall) for nine of the 12 comparable precipitation events (Table 1). In all cases, precipitation pH was significantly (Kruskal-Wallis, $p<0.01$) lower than either deciduous or coniferous throughfall (Table 1). Deciduous throughfall and coniferous throughfall pH were similar for

TABLE 1. Each rainfall event (by date) for the 2008 growing season is presented with amount (mm) and pH of precipitation (measured outside the forest). Throughfall pH (mean and standard deviation [SD]) as measured under deciduous canopy, coniferous canopy, and partially open canopy are presented for each event. Asterisks in the "D vs C" differences column represent significant ($P < 0.01$) differences between deciduous and coniferous throughfall pH. Asterisks in the "C/D vs P" differences column represent events in which both coniferous throughfall pH and deciduous throughfall pH differed significantly ($P < 0.01$) from precipitation pH.

				Throughfall							
	Precip	Precipitation pH		Deciduous pH		Coniferous pH		Partial canopy pH		Differences	
Date (2008)	mm	mean	SD	mean	SD	mean	SD	mean	SD	D vs C	C/D vs P
May 26	2.29	n/a		4.25	0.15	4.31	0.17	4.18	0.10		
May 27	1.27	n/a		4.29	0.32	4.11	0.39	4.30	0.26		
May 31	9.65	n/a		4.25	0.17	4.21	0.17	4.23	0.23		
June 8	1.78	n/a		5.95	0.20	5.82	0.23	5.78	0.30		
June 10	5.33	5.56	0.54	5.35	0.36	5.27	0.24	5.32	0.20		
June 13	32.51	3.71	0.06	4.69	0.41	4.45	0.40	4.19	0.18		*
June 17	3.05	4.82	0.02	6.06	0.29	5.86	0.48	5.82	0.36		*
June 25	4.32	n/a		5.86	0.23	5.61	0.33	5.75	0.22		
June 26	5.33	n/a		6.21	0.19	5.95	0.33	6.17	0.14	*	
June 28	20.32	5.02	1.04	5.47	0.36	5.40	0.30	5.45	0.21		*
July 2	7.87	5.22	0.17	5.74	0.27	5.78	0.24	5.63	0.18		*
July 9	9.14	4.75	0.15	5.99	0.44	5.79	0.34	5.73	0.30		*
July 13	25.65	5.23	0.56	5.29	0.35	4.96	0.42	4.93	0.32	*	
July 17	8.64	4.70	n/a	5.70	0.29	5.43	0.23	5.44	0.28	*	*
July 21	7.87	4.56	0.84	5.49	0.34	5.36	0.56	4.97	0.25		*
July 26	2.03	5.46	0.45	5.54	0.42	5.90	0.55	5.27	0.56		
July 30	3.81	4.79	0.06	5.83	0.34	5.36	0.42	5.45	0.48	*	*
August 9	2.79	4.45	0.10	5.18	0.57	4.94	0.53	4.64	0.34		*

all but four of the censuses. However, for the four census dates with differences (unpaired t-test, $P < 0.01$), coniferous throughfall was more acidic than deciduous throughfall (Table 1).

There were no significant relationships (Spearman-rank correlation) between throughfall pH and precipitation amount or time interval between precipitation events. However, pH was lower (unpaired t-test; $P < 0.001$) in the early portion of the growing season prior to full canopy leaf out which occurred on June 6–7, 2008 in the study site.

Similar to comparison of throughfall with rainfall, the comparison of throughfall pH based on overstory categories: coniferous (n=13), deciduous (n=18), and partially open canopy (n=15) also found significant differences (based on 18 individual ANOVA tests, $P < 0.0001$; post-hoc Tukey tests) for nine of the 18 rain events; three dates in mid-summer (June 13, 25, and 26) and the final six rain events during the study period (July 13–August 9, inclusive). The post-hoc tests showed that for all cases with significant differences, pH of the deciduous throughfall was least acidic; in five cases partially open canopy throughfall was most acidic, and in four cases coniferous throughfall was most acidic.

Species-specific throughfall pH values were generally similar throughout the growing season (Kruskal-Wallis, with Holm's [1979] correction method), with differences ($P < 0.01$) evident for only four (June 13, 26, July 21 and 26) of the 18 rainfall events. In general for those censuses with significant differences, two groups existed (with considerable overlap). Sugar maple throughfall, white spruce throughfall and balsam fir throughfall were statistically more acidic then paper birch throughfall, which was consistently higher than the other species. However, overall the pattern of differences was not consistent throughout the growing season.

DISCUSSION

For all measured rainfall events, precipitation pH in the study site was considerably more acidic than non-polluted rain (pH = 5.6) (Moore 1983), and slightly less acidic than the 4.3 reported for the early 1980s in a study site ≈130 km south of the present study (Morrison et al. 1992). As reported by Moore (1983), coniferous species generally increase throughfall acidity, while deciduous trees generally decrease throughfall acidity. The results from this study suggest that this may not always be the case; in half of the rainfall events both deciduous and coniferous canopies significantly increased pH, a pattern observed by Mahendrappa (1989). However, in the four rainfall events when deciduous and coniferous throughfall pH differed significantly from each other, the coniferous throughfall was more acidic than deciduous throughfall.

Moore (1983) observed that during long intervals between precipitation events deciduous canopies had a high buffering capacity and throughfall pH remained high. Such a pattern was not observed during the period of our study. This may be due to the fact the longest interval during the study period was 10 days, and the average period between rain events was 4.4 days, likely not enough

time for dry deposition to accumulate. The marked decrease in throughfall acidity following full canopy leafout has been observed elsewhere (Shibata and Sakuma 1996), but typically the decrease in acidity following leafout would be most pronounced under deciduous canopies as leafless trees would not buffer rain water as it passes through a leafless canopy. Despite our lack of precipitation pH for the late-May events, clearly this pre-growing season pattern is worthy of further exploration as it may be an important variable affecting seed germination and first year seedling survivorship and growth particularly given the generally poorly buffered soils found in this region (Hutchinson et al. 1998).

Differences in throughfall acidity, controlled by overstory species composition, may be an important factor in creating a highly heterogeneous understory environment which might partly explain understory biodiversity (Wallrup et al. 2006). This is particularly the case given that understory light levels differ under conifer and deciduous canopies (Aubin et al. 2000, Bartemucci et al. 2006), differences exist between deciduous and conifer litter chemistry (Barras and Kellman 1998), and stemflow may be an important contributor to nutrient enrichment at the base of trees which would vary from species to species (Levia and Herwitz 2000). Ongoing research is investigating relative growth rates, carbon assimilation, and mortality rates of sugar maple under various canopy types in the study area.

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CALTHA NATANS PALLAS (RANUNCULACEAE) NEW FOR MICHIGAN AND THUNDER BAY DISTRICT, ONTARIO

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ABSTRACT

We describe newly discovered populations of *Caltha natans* in Michigan and Thunder Bay District, Ontario. This species is a small aquatic plant distributed in a narrow band from northern Alberta to the Lake Superior area. Its distribution in eastern North America is consistent with dispersal by water along the receding ice front or Lake Agassiz shoreline before 9900 years BP, after which dispersal virtually ceased.

Keywords: *Caltha natans*, Michigan, Ontario, post-glacial dispersal

INTRODUCTION

Caltha natans Pall. (floating marsh marigold) is a small, irregularly circumpolar aquatic plant with floating or creeping stems that root at nodes. In contrast to its more common relative *C. palustris* L. (marsh marigold), the heart-shaped, leaf blades of *C. natans* are smaller (2–5 cm wide) and its flowers (1 cm wide) are white-sepaled (rarely pink) and bloom in June to August (Figure 1). Its North American range includes Alaska, Yukon, Northwest Territories, Nunavut, northern British Columbia and Alberta, extending in a narrow band through Saskatchewan, Manitoba and northwestern Ontario to Minnesota and Wisconsin (Ford 1997) (Figure 2).

Habitat for *Caltha natans* in eastern North America is typically shallow, slow-moving streams often associated with beaver disturbance. Populations occasionally extend into shallow waters of lakes near stream mouths. Plants are usually rooted in shallow water on muddy substrate or stranded on mud flats (pers. obs., Lakela 1965, Lakela 1943, Walton 1994). Lakela (1965) also reported the species in drainage ditches in Minnesota.

In Ontario, *Caltha natans* is ranked as S2 (very restricted range, often 20 or fewer populations) (Natural Heritage Information Centre 2008) and is restricted to the western edge of the province, with the exception of a disjunct record in the Ekwan River Basin approximately 75 km west of James Bay (Figure 2) (Riley 2003). The species is locally common on the Aulneau Peninsula on Lake of the Woods and in the southern part of Woodland Caribou Provincial Park on the Manitoba border (pers. obs. A.G. Harris).

Caltha natans is ranked as Endangered in Wisconsin (Wisconsin Department of Natural Resources 2004) and Minnesota (Minnesota Department of Natural Resources 2007). In Wisconsin, it occurs at a single location on the St. Croix River in Douglas County in the northwest corner of the state (Wisconsin State

FIGURE 1. Photo taken September 17, 2007. Malachi Lake area, Kenora District, Ontario (Photo taken by Samuel R. Brinker).

Herbarium 2008). In Minnesota, populations have been found at about five locations in St. Louis Co. but some of these populations have apparently disappeared due to habitat destruction (Lakela 1965, Coffin and Pfannmuller 1988). The species was discovered in Voyageurs National Park (St. Louis County) in 1999 (University of Minnesota Herbarium 2009), and near Duluth in the early 1990s (Walton 1994). Subsequent to its discovery in Michigan (described in this paper), *Caltha natans* was added as Threatened to the Proposed List of Endangered and Threatened Species for Michigan in September 2008 (MDNR 2008).

MATERIALS AND METHODS

We discovered populations of *Caltha natans* while conducting fieldwork in Baraga County, Michigan and Thunder Bay District, Ontario. Subsequently we compiled records of this species in eastern North America from published and unpublished sources: ON: White and Riley 1983, Walshe 1980, previously unreported records from A.G. Harris and R.F. Foster 1998 to 2005; MN: Coffin and Pfannmuller 1988, Lakela 1965, Walton 1994, University of Minnesota Herbarium 2009; WI: Wisconsin State Herbarium 2008.

RESULTS

Baraga County, Michigan

On 26 September 2007, Allan Harris (AGH) discovered a population of *Caltha natans* in a narrow channel draining into Silver River, about 10 km ESE

FIGURE 2. North American distribution of *Caltha natans* (from Ford 1997). Inset area shown in Figure 3.

of L'Anse, Baraga County (46° 43′ N, 88° 19′ W) (Figure 3). About 12 plants were rooted in about 30 cm of water. (Collection: Marr #3745, MICH). On 16 October 2008, Janet Marr, Pam Nankervis, and Todd Warner observed three additional plants growing nearby in shallow water along the edges of Silver River (associates: *Callitriche verna* L. and *Potamogeton* sp.). This population is about 250 km east of the nearest known record, in Wisconsin (Walton 1994).

Lac des Mille Lacs, Thunder Bay District Ontario

On 25 September 2006 AGH discovered a population of *Caltha natans* in a small unnamed stream flowing into Gill Lake, east of Lac des Mille Lacs, in Thunder Bay District Ontario (48° 58′ 26″ N, 90° 26′ 27″ W) (Figure 3). About 20 plants were rooted in 20 cm of water at the edges of the stream with *Sparganium emersum* Rehmann. Substrate was fine sedimentary organic material. (Collection # AGH-06-122, LKHD). The species was not previously known in Thunder Bay District (Thunder Bay Field Naturalists 2003). The Lac des Mille Lacs population is about 130 km northeast of the nearest known record, in Quetico Provincial Park (Walshe 1980).

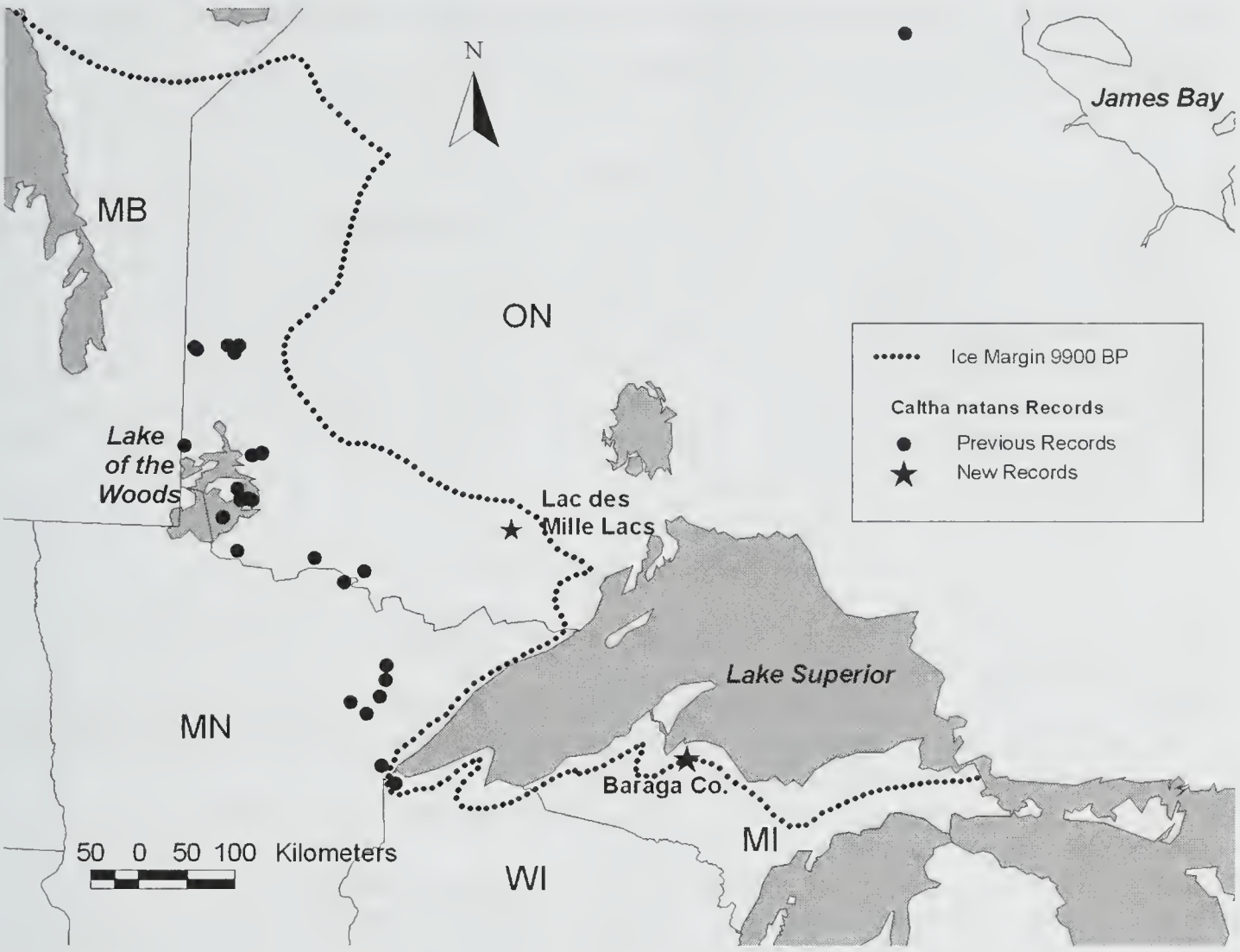

FIGURE 3. Distribution of *Caltha natans* in eastern North America relative to the position of the Laurentian Ice Sheet c 9990 years BP (Teller et al. 1983). All known records from Ontario, Minnesota, Wisconsin, and Michigan are shown.

DISCUSSION

Caltha natans is relatively widely dispersed within about 100 km south of the position of the Laurentide Ice Sheet at about 9900 years BP (Figure 3) (Teller et al. 1983). The species apparently did not disperse to the northeast as the ice retreated, despite abundant potential habitat through northern Ontario. In contrast, some genera of aquatic plants (*Potamogeton*, *Myriophyllum*, *Isoetes*) apparently closely followed the receding ice sheet (Dieffenbacher-Krall and Jacobson 2001). *Caltha* fruits are unspecialized for long-distance transportation by wind or animals (Schuettpelz and Hoot 2004) and water appears to be the most likely dispersal mechanism. The distribution of *Caltha natans* in central North America is consistent with dispersal by water along the receding ice front or Lake Agassiz shoreline before 9900 years BP, after which dispersal virtually ceased. The outlier near James Bay, however, does represent a more recent dispersal since this area was covered by ice or seawater until about 7200 years BP (Thorleifson 1996).

Although apparently quite rare in eastern North America, additional populations of *Caltha natans* may yet be discovered in northwestern Ontario, Min-

nesota, northern Wisconsin, and the Upper Peninsula of Michigan within about 100 km of the 9900 years BP ice margin.

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Edward Voss and Tony Reznicek (University of Michigan Herbarium) verified the identification of *Caltha natans* and helped in getting this species added to the proposed list of endangered and threatened species in Michigan. The Keweenaw Bay Indian Community (KBIC) with a grant from the U.S. Fish and Wildlife Service funded the study that resulted in the discovery of *C. natans* in Michigan. Pam Nankervis and Todd Warner (KBIC) assisted in locating additional *C. natans* plants. Matt Boyd at Lakehead University provided information on Lake Agassiz. Rob Foster, Mike Oldham, Tony Reznicek, Wasyl Bakowsky, and Edward Voss commented on an earlier draft of this paper. Sam Brinker provided the photograph.

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EXTIRPATED *GLYCERIA ACUTIFLORA* NEWLY DISCOVERED IN KENT COUNTY, MICHIGAN

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ABSTRACT

Glyceria acutiflora Torr., a species that was previously listed as extirpated from the state of Michigan, has been rediscovered in a bog in Kent County. *Glyceria acutiflora* was last documented in Michigan by Clarence and Florence Hanes in 1947 and published in *Flora of Kalamazoo County.* Although this species occurs in much of the eastern United States, throughout its range it is consistently uncommon to rare. The discovery of *Glyceria acutiflora* in a small Kent County wetland underscores the importance of preserving and protecting our natural areas and the biodiversity they hold.

Keywords: *Glyceria*, extirpated, wetland, prairie peninsula

INTRODUCTION

In 1947 Clarence and Florence Hanes published *Flora of Kalamazoo County* in which they documented over 50 state records for Michigan including a Brady Township collection of *Glyceria acutiflora* Torr. (Hanes and Hanes 1947). This specimen, initially collected in 1935 (Hermann 1936), along with one by F.W. Rapp in a nearby location in Schoolcraft Township, represent the only known collections of this species in Michigan (McKenna 2004). Previously, *Glyceria acutiflora* had been attributed to Michigan by Hitchcock (1950) but no specimens were referenced and the species did not appear on any statewide distribution maps. Although no additional specimens were found after 1947, *Glyceria acutiflora* was still listed as "threatened" in 1977 (Wagner et al. 1977). However, given such limited documentation and subsequent habitat loss in proximity to where the Hanes specimen was collected in Kalamazoo County, by 1999 *Glyceria acutiflora* was presumed to be extirpated from the state (DNR 1999). Now, nearly 70 years after it was first collected in Michigan, and a decade after it was listed as extirpated, *Glyceria acutiflora* has again been found, this time in Cannon Township of Kent County.

MATERIALS AND METHODS

The first record was collected in a bog moat on private property ½ mile south of 10 Mile Rd. in Kent County, Michigan (46°6′N, 85°28′W, T8N, R10W, NE ¼ of Sec. 3) on June 23, 2000. It was found at this time during a floristic inventory of the townships surrounding the city of Grand Rapids. Additional specimens were collected in the summer of 2003, one of which was sent to the University of Michigan Herbarium (MICH) for confirmation and remains there as a voucher specimen (David

FIGURE 1. Habitat location for *Glyceria acutiflora:* grassy moat area surrounding a *Chamaedaphne calyculata* dominated bog mat.

Warners #2041). Additional voucher specimens are housed in the Herbarium of Calvin College in Grand Rapids (David Warners NAI #307 and #2042-2044).

The bog mat of this site is heavily dominated by leatherleaf (*Chamaedaphne calyculata)* and surrounded by a moat (Figure 1). *Glyceria acutiflora* was growing in the open water of the moat at water depths of approximately 1–2 ft. with a loose mucky substrate at the bottom. This habitat is consistent with the habitat descriptions in several floras reported as "shallow water" and "wet soil" (Hitchcock 1950, Voss 1972, Hanes 1947). At this site, two populations were discovered on opposite ends of the bog, one with approximately 60 culms and the other with approximately 45 culms. In both populations *Glyceria actutiflora* was growing in the deepest water intermingling with G*lyceria borealis* further away from the open water. Found nearby were yellow pond lily (*Nuphar variegata),* threeway sedge *(Dulichium arundinaceum),* floating mannagrass (*Glyceria septentrionalis),* alkali grass (*Puccinellia pallida)*, and wheat sedge (*Carex atherodes*). The bog was surrounded by relatively undisturbed upland oak woodland.

Glyceria acutiflora is a perennial grass that is very slender and rhizomatous with culms

FIGURE 2. Flowering culm of *Glyceria acutiflora* (foreground) with *Juncus effusus,* growing in approximately 50–75 cm of standing water.

50–80 cm in length (Figure 2). Much of the plant grows horizontally on the surface of standing water with the terminal inflorescence 10–20 cm long, erect and exposed above the water. *Glyceria acutiflora* can be distinguished from other wetland/aquatic *Glyceria*—including the recent noteworthy collection of *Glyceria melicaria* (Rafaill 2008)—by its unusually extended palea which projects well beyond the tip of the lemma. This taxon is also more delicate and lax than other *Glyceria* found in Michigan and seems to prefer deeper water than any of its congeneric relatives.

RESULTS AND DISCUSION

South and east of Michigan *Glyceria acutiflora* is found somewhat more commonly although never in abundance. Its range is known to include all of

New England, several southeastern states, and a portion of southern Missouri (Gleason and Cronquist 1991). *Glyceria acutiflora* has also been documented in eastern Asia (Koyama, and Kawano 1964). It seems that the species is most abundant in the New England portion of its range; however, it is a listed species in 9 states including, Maine, Vermont and New Hampshire. The notable absence of *Glyceria acutiflora* from Illinois makes its documented range seem rather strange especially given that it is found in all of Illinois' neighbors to the east and in Missouri to the southwest. Stuckey has postulated that this pattern is the result of the warm dry xerothermic period during which many of the aquatic plants of the prairie peninsula were lost. In support of his hypothesis the range maps of *Glyceria acutiflora* correlate with those of several other aquatic or wetland species found around and east of the Mississippi river; among these are New England bulrush (*Scirpus subterminalis*), ribbonleaf pondweed *(Potamogeton epihydrus),* and Torrey's bulrush (*Scirpus torreyi)* (Stuckey 1983).

Although *Glyceria acutiflora* is by no means an abundant plant, its lack of documentation could be attributed in part to its inconspicuous habit and preference for open water and mucky substrate—a difficult habitat to traverse (Figure 1). Its vegetative similarity to the more common small floating mannagrass (*Glyceria borealis*) may also contribute; although, when reproductive material is present, the bifid-tipped palea surpassing the lemma by up to 3mm makes it possible to distinguish between the two even without a hand lens.

Further exploration of the relative abundance of *Glyceria acutiflora* at this new site in Kent County is certainly warranted. Also, its existence in nearby wetland areas will be assessed. Interestingly, close inspection of satellite maps of the area in Kalamazoo County where F. W. Rapp's specimen was purported to have been found (Hanes and Hanes 1947) reveals a large natural area containing a distinct wetland nearby. This site should also be explored for the possible presence of *Glyceria acutiflora*. For plants that are as rare as this taxon every effort should be made to discover and preserve all genetic lineages if long term conservation of the species is to be a realizable goal.

Discussions with the property owners concerning the preservation of the Kent Co. parcel have taken place although no significant measures have developed at this time. Along with efforts to preserve the site, further research into the genetic diversity of this population and its fertilization requirements is warranted in order to assess its long term conservation potential.

ACKNOWLEDGMENTS

We would like to thank the landowners of the property on which this discovery was made for granting access to their land. Also, the discovery was made during a two-year inventory project of natural areas in the Grand Rapids vicinity that was funded by the Land Conservancy of West Michigan, for which we are grateful. Additionally, we thank Tony Reznicek and Mike Penskar for contributing valuable information and encouragement.

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THE RAM'S HEAD LADY'S SLIPPER (*CYPRIPEDIUM ARIETINUM*): A PRIMER FOR WETLAND PRESERVATION IN THE CARNEY FEN WETLAND COMPLEX, CARNEY, MI

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ABSTRACT

The ram's head lady's slipper (*Cypripedium arietinum* Ait.f.) is listed as a species of special concern throughout its range, and in Michigan the ram's head lady's slipper is considered vulnerable, either because it is rare, uncommon or found only in a restricted range. One of the largest populations of the lady's slipper in Michigan is thought to be in the Carney Fen Wetland Complex. In this study we describe the communities in which ram's head lady's slippers were growing and provide natural resource management and conservation recommendations for the fen and the orchid. The majority of ram's head lady's slippers were located in a hardwood-conifer forest community with the most frequent occurrences found in a transition zone between the rich conifer swamp community and the hardwood-conifer forest (rich conifer swamp edge). The orchid's preferred habitat had an average soil pH of 6.8, ranging from 6.3 to 7.0 and a less dense understory. Ram's head density was positively correlated with percent cover of *Carex pedunculata* Muhl. ex. Willd. and *Eurybia macrophylla* (L.) Cass. This study is an important step in providing information that can be used for the long-term conservation of ram's head lady's slipper habitat and the conservation of the fen ecosystem, which is also the home of at least three other rare plant species.

Keywords: *Cypripedium arietinum*, Orchidaceae, habitat preservation

INTRODUCTION

The ram's head lady's slipper (*Cypripedium arietinum* W.T. Aiton.) is an herbaceous terrestrial orchid found in the temperate Northern Hemisphere. It is listed as a species of special concern in every state and Canadian province in which it occurs (Brzeskiewicz 2000). In Michigan, the ram's head lady's slipper is considered vulnerable either because it is rare, uncommon or found only in a restricted range (Michigan Natural Features Inventory 2003). Although the general ecology of the species is known (Brzeskiewicz 2000), little information on its preferred habitat and characteristics of its habitat is documented. One of the largest populations of ram's head lady's slippers in the state of Michigan is

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believed to occur in the mosaic of plant communities of the Carney Fen Wetland Complex in Carney, Michigan.

Plant enthusiasts, who have discovered the existence of rare orchids such as the ram's head lady's slipper (*Cypripedium arietinum*) along with other distinctive plant species, have visited the Carney Fen Wetland Complex for many years. The Carney Fen is located within a complex of wetland communities, dominated by a rich conifer swamp. The area contains a northern fen, which is not common in the Upper Peninsula of Michigan (Michigan Natural Features Inventory, 2003). Since this wetland complex harbors a large assemblage of orchid species, some of which are rare, there is concern for its protection.

Although this wetland is located within state land, very little information is known about the ecology, plant communities, hydrology, wildlife and function of the ecosystem as a whole. It is known that this wetland complex contains habitats and soils described by Brzeskiewicz (2000) that support the ram's head lady's slipper orchid (i.e., cool, slightly acid or neutral soils in dense white cedar/balsam fir/spruce swamps or in mesic sandy loam or clay textured soil under the partial shade of a mixed forest). Select areas of the fen are still actively managed for timber by the Michigan Department of Natural Resources (MI DNR), however approximately 2325 acres of the Carney Fen Wetland Complex were officially designated as a Michigan Natural Area in 2009 due to the dedication of many volunteers and in part, this study (Wolfe, 2006).

In this study, 31 known ram's head locations were surveyed in three different habitat types to describe plant species diversity, vegetative and physiographic characteristics, and soil properties. Study plots, which did not contain ram's head orchids, were also surveyed to provide comparative data on ram's head habitat. Based on the rarity of ram's head lady's slipper and interest in protecting this wetland complex, this study provides baseline ecological information on a scientifically overlooked area.

METHODS

Study Species

The ram's head lady's slipper is Michigan's smallest native lady's slipper orchid (Case 1987) having a distinctive conical pouch with purple, crimson or green net-like venation on the lip (Penskar and Higman 1999). It is only 0.7 to 3 dm tall with leaves 3 to 5 in number (Case 1987). The flower is about the size of a thumbnail, about 1.5 to 2.5 cm long and 1.2 cm wide (Case 1987). The ram's head lady's slipper can be found growing individually or in clusters of up to 12, blossoming in mid-May to early June (Brzeskiewicz 2000). They can remain in flower for a week or so if the weather is cool and the flower is not pollinated (Case 1987). The ram's head lady's slipper does not produce flowers every year causing difficulties with field identification (Penskar and Higman 1999). This species has been considered rare for a long time yet this could be due to the fact that it often goes unnoticed given the small size (Case 1987). A common feature of ram's head habitat is an open, uncrowded under-story layer with low competition from other plants (Alverson & Solheim 1980). According to Case (1987), this orchid needs cool soil and shelter from direct sun. Although ram's head lady's slippers grow to their largest size in swamps and bogs, it is most abundant in the drier upland habitat commonly growing in multi-stalk clumps (Ostlie 1990).

Study Area

The Carney Fen Wetland Complex, a local name, is located within the Escanaba River State Forest about 4.5 miles west of Carney, Michigan. The Carney Fen is located on a USGS map in the

FIGURE 1. *Cypripedium arietinum* (Photo taken by Ross Wolfe in 2004).

Banat quadrat at 45.57° north, 87.66° west within the Menominee River Watershed, HUC 04030108. The exact boundaries of the Carney Fen Wetland Complex have not been delineated, but the target area of this study includes four timber compartments, approximately 4000 acres in size. The entire 4000-acres fall within Sections 17, 18, 20, 21, and 28–33, Township 33 North, and Range 27 West. The annual precipitation for this area is 31 inches/year and the average temperature is 42° F (http://climate.geo.msu.edu/stations/7867/).

Fen wetland habitats, like the Carey Fen, are rare in Michigan and are considered to be highly unique and important places for species diversity (Sargent and Carter 1999). Fen wetlands in general represent some of the rarest and most biologically diverse wetlands in temperate zones of the United States (Amon et al. 2002) and elsewhere. Rich conifer swamps, which dominate the fen, are one of the most floristically diverse natural communities in the upper Midwest, providing habitat for more than 25% of Michigan's wildlife species significantly contributing to the overall diversity of the northern Great Lakes region (Kost 2002). An example of this diversity is the discovery of a state listed orchid (*Calypso bulbosa* (L.) Oakes in the fen, which has not been seen there in over 30 years, a federal and state listed iris (*Iris lacustris* Nutall), endemic to the Great Lakes region and at least 26

other orchid species (Wolfe, 2006). There is reason to believe this wetland contains even more rare plants and possibly rare animals and is a fragile ecosystem in need of protection.

The Carney Fen is part of a drumlinized ground moraine with drumlins throughout the landscape running northeast to southwest. The study site contains a complex of wetland communities, dominated by a rich conifer swamp and pockets of upland hardwood-conifer forests. The majority of the wetland ecosystem is considered a northern fen connected by groundwater flow, mineral rich water surfacing throughout and small weakly developed streams.

Data Collection

Extensive transects were run throughout the 4000 acre wetland complex to collect GPS locations of ram's head lady's slippers. To determine the ecological characteristics of the ram's head lady's slipper habitat, quantitative data were collected on vegetation, hydrology and soils within 31 randomly selected ram's heads locations stratified across three habitat types of the Carney Fen. The stratified samples were located within a rich conifer swamp interior, the edge of the rich conifer swamp, and a hardwood-conifer forest. Sampling sites were considered to be in the edge of the rich conifer swamp if they were within 100 meters (m) of the transition between the upland hardwood-conifer forest community and the rich conifer swamp community. Community type descriptions were based on the average of ram's head locations and randomly selected plots, which did not contain the orchid. Non-ram's head plots (n=23) were located in a random direction 33m from the located ram's head plot center.

Each tree species was identified and the dbh recorded. For the purposes of this study, trees were considered any woody plant with a dbh (diameter breast height) of ≥ 7.5cm. Snags, which were defined as a standing, partly or completely dead tree, often missing a top or most of the smaller branches, ≥7.5cm dbh, were identified to species if possible, with the dbh and one of four decay classes being recorded using the following categories: 1) recently dead (≥1/3 crown remaining), 2) ≤ 1/3 crown remaining: not snapped off, 3) snapped off, loose bark, 4) snapped off, soft wood. Trees and snags (>7.5cm) were measured in a 11.3 m radius (1/25 hectare) plot in the hardwood-conifer forest and rich conifer swamp edge habitats and a 5.6m radius (1/100 ha) in the rich conifer swamp interior habitat. A tree core was extracted and heights were measured on three co-dominant tree species in each plot using a Suunto increment borer and Suunto clinometer to determine community age. The percent cover of shrubs and/or saplings ≤7.5cm dbh and ≥ 1m tall was estimated in nested 5.6 m radius (1/100 ha) plots centered on the tree plot in all three habitats. The percent cover of herbaceous and woody species ≤1 m tall was estimated in three $1m^2$ plots randomly placed throughout the tree plot. Percent cover was estimated based on six coverage classifications with the potential for the average percent cover to be greater than 100% when different species had overlapping leaf cover (Wolfe 2006).

When additional rare or endangered species were located, aside from ram's head lady slipper, they were recorded and mapped so that detailed surveys could be performed in the future. When necessary, rare plants were documented using Michigan Natural Features Inventory Special Plant forms. Plant specimens were taken for identification purposes although plant collection was minimized as much as possible. The majority of plant identification was made in the field with the primary reference being Michigan Flora volumes I, II & III by Edward G. Voss (1972, 1985, 1996). Gary Fewless, Herbarium Curator, Cofrin Arboretum Botanist and Professor at the University of Wisconsin Green Bay, assisted in verifying unknown specimens and assisted with field identification. Other sources included Peterson's Field Guides (Ferns, Wildflowers and Trees and Shrubs), The Flora of the Northeast (Magee 1999) and Newcomb's Wildflower Guide (Newcomb 1977). For a complete list of species identified, please refer to the master's thesis report (Wolfe 2006).

Soil organic matter depth was measured in the $1m^2$ plots near a ram's head lady's slipper plant and a soil sample was collected to determine soil pH in a laboratory. The same measurements were recorded in non-ram's head plots, although in these plots soil measurements were taken in the center of each of the $1m^2$ plot.

Data Analysis

A comparison of species composition and structure between ram's head habitat and non ram's head habitat was completed by calculating frequency, relative cover, relative density, density/ha of trees, snags, shrubs and saplings and mean percent cover herbaceous species for ram's head plots and

non-ram's head plots. *It should be noted that mean percent cover of shrubs and herbaceous species can be greater than 100% based on the overlap of species in a given plot.* These relative values were used to determine an importance value for each species within each habitat type and to verify the predefined habitat types. The importance values were also calculated per synusia *(Upper Synusia= Trees, Middle Synusia= Shrubs/samplings, Lower Synusia= herbaceous species).* Density per hectare was calculated for both ram's head plots and non-ram's head plots using the total counts of species for each synusia. Species richness (the number of different species in a given area) was calculated for each synusia and habitat type. Species diversity was calculated for both ram's head plots and non-ram's head plots and each synusia using Simpson's Index (1949) which incorporates the number of species in an area and their relative abundance. A non-parametric Kruskal-Wallis test was used to compare mean values of vegetation and physiographic variables between ram's head and non-ram's head plots. This same test was used for the Simpson's Index (1949) and the Floristic Quality Index (Herman et all 2001). Spearman's Rho was used to examine correlations among ram's head density/ha and the vegetation and physiographic variables in each synusia. Logistic regression helped to determine which of the vegetation and physiographic variables were useful in predicting a ram's head lady's slipper occurrence. To determine if ram's head plots were significantly different from non-ram's head plots, a multivariate analysis was conducted using all vegetation and physiographic variables. The dependent binary variable was the presence or absence of the ram's head lady's slipper.

A Floristic Quality Index (FQI) and mean coefficient of conservatism (C) for each of the habitat types was calculated using the method described in "Floristic Quality Assessment with Wetland Categories and Computer Application Programs for the State of Michigan" (Herman et al 2001). This method is used to determine the floristic quality of an area based upon the plants identified at the site. Each native plant has been assigned a coefficient of conservatism (C) value with a range of zero to ten (Herman et al 2001). Zero values were given to species that may be found almost anywhere and a higher value of 8 to 10 would be given to plants that are almost always restricted to a high quality area (Herman et al 2001). These values can be used to identify remnant native habitats of floristic significance or to compare the floristic quality among different sites (Herman et al 2001). According to Herman et al (2001), if the C for the site is 4.5 or higher or has an FQI of 45 or more, it is almost certain that the remnant has natural area potential with high floristic quality.

RESULTS

Carney Fen Communities

Two defined ecological communities, a rich conifer swamp, and hardwood-conifer forest, as well as a transitional or edge habitat are described in this study (rich conifer swamp edge). These communities differed in structural characteristics and species diversity. The rich conifer swamp had the highest basal area 55 ± 15.8 (m^2/ha) and a shrub density of 135.5 ± 128.8 (stems/ha) compared to the edge habitat 39.6 ± 22.4 (m^2/ha) and 51.6 ± 51.1 (stems/ha) (Table 1). The hardwood-conifer forest had the lowest basal area of trees 27.0 ± 14.7 (m^2/ha) and the highest percent cover of herbaceous species 131.9 ± 44.8 (species/ha) and the highest density/ha of snags. The rich conifer swamp was dominated by Eastern white cedar (*Thuja occidentalis*) with associate species including: tamarack (*Larix laricina*), black spruce (*Picea mariana*) and balsam fir (*Abies balsamea*). The hardwood-conifer forest was dominated by balsam fir (*Abies balsamea*), trembling aspen (*Populus tremuloides*), red maple (*Acer rubrum*), and paper birch (*Betula papryifera*) in the overstory. The rich conifer swamp edge, identified as being an important habitat for the ram's head lady's slipper in the Carney Fen ecosystem, is the transition between the rich conifer swamp and the hardwood-conifer forest. Variables measured such as soil pH, tree height, and age of

TABLE 1. Mean values of variables measured between forest communities, Carney Fen Wetland Complex, Carney, Michigan. (Mean ± 1 standard deviation, n)

Vegetation Parameters	Rich Conifer Swamp	Rich Conifer Swamp Edge	Hardwood-Conifer Forest
Basal Area (m^2/ha) TREES	54.69 ± 15.8, 23	39.61 ± 22.4, 19	26.6 ± 14.7, 12
Diameter Breast Height (dbh), TREES	433.7 ± 136.7, 23	458.7 ± 258.1,19	375.4 ± 196.6, 12
Density/ha TREES	137.16 ± 57.53, 23	80.8 ± 45.79, 19	95.28 ± 35.4, 12
Basal Area (m^2/ha) SNAGS	4.4 ± 3.1, 18	3.5 ± 2.5, 22	5.6 ± 2.7, 11
Diameter Breast Height (dbh), SNAGS	35.2 ± 20.9,22	83.7 ± 83.3, 18	95.4 ± 78.9, 11
Density/ha SNAGS	14.2 ± 8.7,22	19.6 ± 25.6, 18	24.5 ± 10.5, 11
Density/ha SHRUBS	135.5 ± 128.8, 22	51.57 ± 51.1, 19	91.01 ± 124.0, 12
% cover, SHRUBS /SAPLINGS	35.5 ± 32.1, 22	24.4 ± 16.2 , 19	30.9 ± 30.8, 12
% cover, HERBS	89 ± 33.9, 23	112 ± 40.2, 20	131.9 ± 44.8, 12
Physiographic Variables			
Soil pH	6.9 ± 0.5, 25	6.7 ± 0.5, 22	6.68 ± 0.4, 19
Organic Matter Depth (cm)	20, 23	13.4 ± 5.9, 19	17 ± 1.8, 11
Tree Height (m)	14 ± 2.4, 23	15 ± 2.7, 19	17.3 ± 2.1, 5
Habitat Age (years)	84 ± 12.6, 23	74 ± 15.7, 19	62 ± 11.7, 9
% Canopy Cover	86.9 ± 4.9, 23	75.8 ± 13.4, 19	81.7 ± 12.2, 12
Elevation (feet)	845.1 ± 40.8, 22	827.7 ± 62.1, 19	842 ± 24.1, 11

the forest show that the edge habitat was truly the transition between the upland and lowland plant communities as many values for the edge habitat lie between the rich conifer swamp and hardwood-conifer forest (Table 1). The hardwood-conifer forest and rich conifer swamp edge habitat had similar species richness with 19 and 17 species respectively in the upper synusia (Table 2). The rich conifer swamp was much less species-rich with only 11 species in the upper synusia and had the lowest species diversity in the upper and middle synusia. The hardwood-conifer forest had the highest species diversity in the upper synusia, while the rich conifer swamp edge has the highest species diversity in the middle and lower synusia (Table 2).

TABLE 2. Species richness and species diversity for ram's head plots in the upper, middle and lower synusia of three plant communities, Carney Fen Wetland Complex, Carney, Michigan. *The Simpson's Index gives a range of values between zero and one.* ***The closer the number is to zero, the more diverse the habitat.***

	Trees		Shrubs		Herbs	
Habitat	Species Richness	Simpson's range 0–1	Species Richness	Simpson's range 0–1	Species Richness	Simpson's range 0–1
Rich Conifer Swamp	11	0.61	11	0.28	105	0.05
Hardwood-Conifer Forest	19	0.15	16	0.24	99	0.08
Rich Conifer Swamp Swamp Edge	17	0.47	15	0.17	118	0.03

TABLE 3. Kruskal-Wallis statistical results showing significant differences between ram's head plots and non-ram's head plots in the Rich Conifer Swamp community, Carney Fen Wetland Complex, Carney, Michigan. (Mean ± 1 standard error, n)

	Rich Conifer Swamp Community		$P = 0.0488$	
Community Age	Mean	Std Err Mean	Lower 95%	Upper 95%
Ram's Head Plots	76.5 ± 13.5, 12	3.91	67.9	85.1
Non-Ram's Head Plots	87.75 ± 11.5, 11	3.45	80.1	95.4
	Rich Conifer Swamp Community		$P = 0.0089$	
Soil pH	Mean	Std Err Mean	Lower 95%	Upper 95%
Ram's Head Plots	7.1 ± 0.4, 12	0.1	6.8	7.3
Non-Ram's Head Plots	6.5 ± 0.5, 11	0.1	6.2	6.9

**NOTE: The Rich Conifer Swamp was the only forest community which demonstrated significant differences between ram's head and non-ram's head plots among the variables measured*

RAM'S HEAD LADY SLIPPER'S HABITAT

Ram's head lady's slippers were found in great numbers in the Carney Fen. The average density/ha of ram's head lady's slippers for all habitat types was 197.4 plants/ha. The average ram's head lady's slipper density was 196.9 in the rich conifer swamp, 179.4 on the edge of the rich conifer swamp and 422.8 in the hardwood-conifer forest. Soil pH for all ram's head plots was 6.8 ± 0.4 and the depth of the organic matter was 14.2 ± 6.9 inches. The only significant differences in vegetation parameters were found in the rich conifer swamp. Kruskal-Wallis results show ram's head plots in the rich conifer swamp to have a significantly younger mean habitat age ($P = 0.0488$) and a significantly more semi-acidic to neutral mean pH compared to non-ram's head plots ($P = 0.0089$) (Table 3).

Ram's head locations differed significantly from non-ram's head locations based on the results of a multivariate comparison involving 13 of the variables measured including soil pH, elevation, percent canopy cover, density of trees and shrubs, tree height and percent cover of herbaceous species ($P = 0.0168$). Logistic regression results show both individual variables and combinations of variables to be significant predictors of ram's head lady's slipper habitat (Table 4). For example, a lower mean shrub density ($r = 0.1118$, $P = 0.041$) and a more semi-acidic or neutral pH ($r = 0.0614$, $P = 0.0335$) were found to be indicators of ram's head lady's slipper habitat. In addition, a higher mean percent cover of herbaceous species *Polygala paucifolia* and *Eurybia macrophylla* could also be considered predictors of ram's head lady's slipper habitat ($r = 0.1216$, $P = 0.0113$). Further, when combined, a lower mean shrub and sapling density/ha, lower mean snag basal area m^2/ha and lower mean percent cover of shrubs and saplings were shown to be significant predictors of ram's head lady's slipper habitat ($r = 0.2654$, $P = 0.0006$) (Table 4).

Based on non-parametric correlation analysis between density of ram's head lady's slippers/ha and all of the variables measured, a few modest negative and

TABLE 4. Logistic regression results demonstrating which of the variables measured are significant predictors of ram's head lady's slipper habitat, Carney Fen Wetland Complex, Carney, Michigan.

Variable	Statistically significant value
Soil pH Organic Matter Depth	r = 0.1474, *P* = 0.0044
Eurybia macrophylla *Polygala paucifolia*	r = 0.1216, *P* = 0.0113
Soil pH	r = 0.0614, *P* = 0.0335
Mean Shrub Density	r = 0.1118, *P* = 0.041
Mean Shrub Density Mean percent cover Shrubs Mean Snag Density	r = 0.2654, *P* = 0.0006

positive correlations were found. The highest positive correlation noted was between mean ram's head lady's slipper density/ha and the mean percent cover of herbaceous species *Eurybia macrophylla* (Spearmans' Rho = 0.4381 *P* = 0.0137) and *Carex pedunculata* (Spearmans' Rho = 0.4312, *P* = 0.0154). On the other hand, mean ram's head density was negatively correlated with mean percent cover of *Corylus spp.* (Spearman's Rho = -0.546, *P* = 0.0015).

Ram's head plots show a significantly higher Floristic Quality Index (FQI) compared to non-ram's head plots (*P* = 0.0495) (Table 5). The rich conifer swamp showed the highest Coefficient of Conservatism (C) with a value of 5.6 and the rich conifer swamp edge had the highest Floristic Quality Index (FQI) score of 42.9. Over all three habitat types, the C value was 5.3 and the FQI value was 51.9 (Table 5).

TABLE 5. Floristic Quality Assessment (FQA) between community types, Carney Fen Wetland Complex, Carney, Michigan.

C = mean coefficient of conservatism, FQI= Floristic Quality Index. If C for the site is 4.5 or higher or has an FQI of 45 or more, it is almost certain that the remnant has natural area potential with high floristic quality (Herman et al 2001).

Ram's Head Plots **Community Type**	**C**	**FQI**
Rich Conifer Swamp	5.6	42.7
Rich Conifer Swamp Edge	5.2	42.9
Hardwood-Conifer Forest	5.0	41.2
All Communities	5.3	51.9
NON-Ram's Head Plots **Community Type**	**C**	**FQI**
Rich Conifer Swamp	5.1	40.1
Rich Conifer Swamp Edge	4.7	37.3
Hardwood-Conifer Forest	4.5	32.3
All Communities	5.0	47.8

P = 0.0495

DISCUSSION

While only a few significant differences were noticed in the rich conifer swamp interior habitat type between ram's head lady's slipper plots and non-ram's head lady's slipper plots, there were obvious trends in the variables collected allowing ram's head habitat within the Carney Fen Wetland Complex to be more clearly defined. Since ram's head plots across all habitat types exhibited an overall lower mean percent cover and density/ha of shrubs and saplings and a lower mean percent cover of herbaceous species, it is clear that ram's head lady's slippers prefer areas with less competition in the lower and middle synusia, reaffirming what the literature has indicated (Alverson and Solheim 1981). Ram's head lady's slippers favored a mid-successional forest (67 to 79 years old), and a narrow range of soil pH (6.3–7.0). The results demonstrate that ram's head lady's slippers do not favor too much sun, preferring a partially closed canopy, which reaffirms what Ostlie (1990) found throughout the region. Ram's head lady's slippers predominantly grow in litter or moss, preferring moist to saturated conditions on low hummocks (Wolfe 2006). Ram's head lady's slippers also predominantly grew in areas with medium to high hummock density, demonstrating the importance of microtopography in providing suitable habitat for these orchids (Wolfe 2006).

Ram's head lady's slipper plots were shown to have a significantly higher Floristic Quality Index (FQI) compared to non-ram's head plots. A higher FQI of ram's head plots confirms that ram's head lady's slipper have a preference for rich sites that also support high species diversity (Brzeskiewicz 2000). Although this study showed that many variables are important in determining ram's head lady's slipper habitat, soil pH and habitat age are both significant factors in understanding where the orchid will grow, specifically on the edge of the rich conifer swamp. In addition since certain species like *Eurybia macrophylla* were positively correlated with ram's heads it could be used as an indicator of ram's head lady's slipper habitat.

The three habitats examined in this study provide the cool soil and protection from direct sunlight that ram's head lady's slippers need to survive. Similar to a study on orchids in Rhode Island (Stuckey 1967), the ram's head lady's slippers seem to be part of transitional vegetation in the Carney Fen, with higher densities of ram's head found on the edge of the rich conifer swamp and the hardwood-conifer forest compared to the rich conifer swamp interior. Based on two years of research in the Carney Fen Wetland Complex, focusing on ram's head lady's slippers, it is obvious there is a healthy population of this orchid with an extensive range throughout the focus area. However, many human disturbed areas, particularly due to logging activity and ATV use were noticed and have the potential to be detrimental to the survival of the target species and other rare plants. Clear-cutting and excessive thinning are major threats to this species as ram's head lady's slipper plants are unable to tolerate the resulting increased sunlight (Ostlie 1990). In addition, altering water levels may have profound impacts on ram's head lady's slippers occurring in lowland situations (Ostlie 1990).

According to Ostlie's report (1990), a diversity of habitats will provide the

best possibilities of long-term survival of this orchid, and if logging is to be done, only selective logging is recommended. With this being said, areas that are designated for clear-cut harvest or final harvest in the Carney Fen, should only occur in areas where the MI DNR is confident ram's head lady's slippers and other rare plants do not occur and where ram's head and other sensitive species are found, an appropriate buffer should be used. According to Brzeskiewicz (2000), a conservation strategy is necessary to provide for the long-term conservation of ram's head (i.e. for at least 20+ years). Since the responses of ram's head orchids to disturbance regimes are not well understood (Brzeskiewicz 2000), monitoring populations in successional habitats should be conducted to determine whether the maturing of these habitats would create conditions unfavorable to the ram's head lady's slipper or other orchids in the Carney Fen Wetland Complex.

It is recommended that a conservation strategy be developed for the Carney Fen Wetland Complex, particularly involving the ram's head lady's slipper as well as the other rare species documented. The continuation of volunteer efforts to document orchids and any other species in this area, coupled with continued cooperation with the MI DNR are strongly recommended to continue the protection of this area.

In the context of this paper it is important to announce that on June 14th, 2009, approximately 2325 acres of the Carney Fen Wetland Complex were officially designated as a Michigan Natural Area in Carney, Michigan in which over 100 people attended to show their support for this unique and special place. The Carney Fen Natural Area is Michigan's 22nd Natural Area, the first to be dedicated in over 20 year and the only one of it's kind in the Upper Peninsula. The Carney Fen would not have become a natural area without the persistence, hard work and dedication of many volunteers and in part, this study. If you want to learn more about Michigan Natural Area Legislation, or the Carney Fen Wetland Complex please contact the Natural Areas Program, Michigan Department of Natural Resources – Wildlife, Phone #517-373-1263.

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This study would not have been possible without the financial support of the Hane's Trust, Michigan Botanical Foundation and Menominee County Conservation District. Sincere thanks to the faculty in the Environmental Studies Department at Antioch Univieristy New England for all their support. I am also very grateful for the hard work of my field assistants, Elisha Wolfe, Jesse Rhodes and Jill Fineis; and the many volunteers who dedicated their time and energy to this project.

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IN MEMORIUM—ELWOOD BERNHARD "WOODY" EHRLE

Nancy D. Ehrle and Dennis W. Woodland

Dr. Elwood Bernhard "Woody" Ehrle, former Academic Vice President of Western Michigan University and Professor of Biological Sciences Emeritus, passed away on 19 July 2009 at Bronson Hospital, Kalamazoo, MI, following a fall and short illness.

Woody was born on November 13, 1933, the son of Katherine and Elwood Ehrle of Clifton, NJ. His family owned and operated a florist and nursery business in Clifton for over 30 years. Woody's earliest botanical training was from his grandfather, George L. Ehrle, who, in 1925, produced the world's first double-flowered "Baby's Breath," now the florist standard all over the world. He graduated from Clifton High School in 1950. Woody earned a B.S. Degree in Ornamental Horticulture from Rutgers University in 1954, an M.A. degree in Botany from Columbia University in 1955, and a Ph.D. degree in Botany from Pennsylvania State University in 1958. He was Professor of Botany at Geneseo State University, Geneseo, NY from 1958–68 with a sabbatical leave taken at Cornell University to study Radiation Biology in 1965–66. He was Associate Director of the American Institute of Biological Sciences in Washington, DC from 1968–71. Woody was Dean of Arts & Science at Mankato State University, Mankato, MN, from 1971–76 and Academic Vice-President at Indiana State University in Terre Haute, IN from 1976–79. Woody was Academic Vice President at Western Michigan University from 1980–83. In 1984 he returned to his first love, teaching people about plants, and became Professor of Biological Sciences at Western Michigan University, a position he held until his retirement in 1999. Following retirement, Woody and his wife donated to help update the student/display portion of the WMU Biology Department Greenhouses in honor of his grandfather. It is now known as the George L. Ehrle Greenhouse.

Woody received the WMU Alumni Association's Teaching Excellence Award in 1995 and was loved and appreciated by his students. He enjoyed leading students and members of the Michigan Botanical Club (MBC) on field trips to distinctive habitats in the southwestern Michigan area or to the Lake Michigan dunes, where, along with flowering plants, he would also expound about any interesting mosses found. Woody taught classes for the Michigan State University Extension Service Master Gardener Program and the training program of the Michigan Federation of Garden Clubs.

Professionally, he wrote two books and published over 150 scientific and academic papers in 20 different journals, especially in the area of bryology. He collected more than 8,000 herbarium specimens, which are housed in the New York State Museum in Albany (NYS), the Hanes Herbarium at Western Michigan University (WMU) and a small collection of New York vascular plants and Michigan mosses at the Andrews University Herbarium (AUB).

In the early 1990s, the Michigan Botanical Club fell on difficult times.

Woody, with his administrative abilities, was voted president and immediately began getting the club functioning again. While President of MBC, Woody began his big tree work with Paul Thompson in 1992. He became Michigan's Big Tree Coordinator in 1994 and continued traveling the state, measuring trees and giving big tree talks to many groups. Woody received the Distinguished Service Award of the Michigan Botanical Club in 1998 and the Forestry and Parks Association Award for Meritorious Service with Michigan's Big Trees in 2002. He served for a number of years as Chairman of the Board of the Hanes Trust Foundation of Kalamazoo, established "to facilitate the study of Michigan plants." The fund makes about 10–20 grants per year for this purpose.

Woody enjoyed gardening in the summer and chopping wood for his fireplace in the winter. In the winter months, he and his "bride" Nancy, of 52 years, enjoyed each evening a pre-prandial libation in front of a roaring fire. He loved traveling, and he and Nancy enjoyed 19 cruises to many parts of the world.

Woody leaves his beloved wife, Nancy Decker Ehrle; three sons: Erik (Jean-deceased) of Cincinnati, OH, Ben (Susan) of Valparaiso, IN and Royce (Lisa) of Aurora, CO. He also leaves a grandson, Aaron; and four granddaughters: Jessamine, Emily Rachel, Emily Josephine, and Celia. He was preceded in death by his parents and a brother, Donald.

Woody's legacy will continue to benefit students of botany in Michigan. The Michigan Botanical Foundation (MBF) was set up as a 501c3 organization under Woody's guidance in the mid-1990's to fund small grants toward a better understanding of plants. In accordance with Woody's wishes, a sizable bequest from his estate has been given to the MBF to further its work promoting botany in Michigan. Additional memorial contributions may be made in his memory to the Michigan Botanical Foundation, c/o Patrick Fields, Chair, 5349 North Canal Road; Dimondale, MI 48821-8712 or to Robert Sabine, Treasurer, P.O. Box 332, Grand Haven, MI 49417.

(NDE: nancyehrle@sbcglobal.net; DWW: woody@andrews.edu)

ODE TO MY GRANDPA

by

Emily Rachel Ehrle (age 18)

Some are old
Some are chatty
Some are cold
Some are just batty.

But today the one I have in mind
Is a grandfather of a special kind
He loved gardens
Was a friend to every tree
But the most important thing he grew
Was his family.

To measure champion trees
He made a science
Even in bad times
He lived with death defiance.

But then the day came when he went away . . .

If you listen now in the forest depths
You will find he didn't leave us behind
A part of him is still left.
His children and grandchildren live
He did not die
I insist he still exists in each of us – you and I.

It's a gift to remember, you see
The blessing of his memory.
Today and all days he will still aspire
To fly in the forest trees with the birds
If not higher.

His death is not the end of his art
To think of all he did
Is not to measure a tree
But to measure a man's heart.

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CONTENTS

Throughfall pH in a Mixed Deciduous-Coniferous Forest, Ontario, Canada: The Effect of Overstory Species Composition
David Goldblum and Lesley S. Rigg 65

Caltha natans Pallas (Ranunculaceae) New for Michigan and Thunder Bay District, Ontario
Allan G. Harris and Janet Keeney Marr 72

Extirpated *Glyceria acutiflora* Newly Discovered in Kent County, Michigan
Peter D. Hiskes and David P. Warners 78

The Ram's Head Lady's Slipper (*Cypripedium arietinum*): A Primer for Wetland Preservation in the Carney Fen Wetland Complex, Carney, MI
Yarrow Wolfe, Peter A. Palmiotto, and Dennis Magee 83

In Memorium—Elwood Bernhard "Woody" Ehrle
Nancy D. Ehrle and Dennis W. Woodland 94

On the cover: *Looking south towards the boundary between the deciduous forest and boreal forest along the eastern shore of Lake Superior in Lake Superior Provincial Park, Ontario, Canada. Photo taken by David Goldblum, May 15, 2009.*

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RARE PLANT SPECIES AND PLANT COMMUNITY TYPES OF MANITOU ISLAND AND GULL ROCK, KEWEENAW COUNTY, MICHIGAN

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ABSTRACT

Botanical and ecological surveys of Manitou Island and Gull Rock were conducted in 1996 and 2005 to relocate and update the status of rare species associated with volcanic bedrock shoreline, as well as search for additional rare vascular plant species not previously known for Manitou Island. An additional objective of 2005 surveys was to search the interior of Manitou Island for rare plants, and to more comprehensively classify and describe the vegetation types of Manitou Island.

Manitou Island is located in Lake Superior about 5 km east of the tip of the Keweenaw Peninsula in Keweenaw County, Michigan. Manitou Island's shoreline is comprised primarily of cobble beaches, steep sloping bedrock, and cliffs. The island's bedrock shoreline has one of the highest concentrations of rare plant species for this natural community type in Michigan. One state endangered, nine state threatened, and four special concern species, several of which have boreal and arctic affinities, are now documented for Manitou Island, including two newly documented species, northern reedgrass (*Calamagrostis lacustris*) and fir club-moss (*Huperzia selago*), discovered in the island's interior during the recent 2005 surveys. Low summer temperatures and fogs along the Lake Superior shore create arctic-alpine-like climatic conditions, and in combination with volcanic bedrock along the shoreline, provide habitat similar to that found farther north, where these plants are more common. No rare plant species were documented during 2005 surveys of Gull Rock, a small bedrock island of ~0.2 hectare located about 1 km west of Manitou Island.

Keywords: Keweenaw County, Manitou Island, Gull Rock, rare plants, Lake Superior, bedrock shoreline, Great Lakes islands

INTRODUCTION

> "*From its flora, that island [Manitou Island] looks to me like a place as interesting as Isle Royale.*" E. G. Voss (pers. comm.).

The 30,000 islands of the Great Lakes are globally unique and significant in terms of their high level of biological diversity (Crispin 1998) including the botanically-rich Isle Royale, Apostle, and Slate archipelagos of Lake Superior. These island groups have been the subject of numerous collecting expeditions, research projects, and status surveys (e.g. Foster et al. 1998; Judziewicz 1993,

1997; Slavick and Janke 1993; McGregor 1974). Lake Superior's Manitou Island, located 5 km east of the tip of Michigan's Keweenaw Peninsula, exemplifies the biological richness and importance of a smaller Lake Superior island, which despite its proximity to the mainland has been studied much less intensively.

In addition to providing critical habitat for a diversity of breeding and migratory bird species (Wood 1933; Youngman 2004), Manitou Island is known for supporting a relatively large number of rare plant species. Seven Michigan endangered, threatened, and special concern species were collectively documented for this Keweenaw County island over a period of botanical exploration from 1950–1982 (Richards 1952; Thompson and Wells 1974; Voice et al. 1982). One rare taxon, the state endangered northern marsh violet (*Viola epipsila*) has not been documented elsewhere throughout the eastern United States (Ballard 1985).

Most of the rare plant taxa discovered on Manitou Island in studies from 1950–1982 were documented in natural communities on or near the island's bedrock shoreline (Figure 1). The less accessible upland, wetland, and aquatic communities present in the island's interior, all with the potential to harbor additional rare plant species, do not appear to have received comparable examination.

The botanical and ecological surveys conducted in 1996 (Albert et al. 1997) and in 2005 (Marr 2006) were dedicated in part to relocating and providing updated status information for historical and otherwise very dated occurrences of rare species. These surveys were also focused on searching for additional rare

FIGURE 1. Copper Harbor Conglomerate bedrock shoreline of Manitou Island. Photo taken near the island's west end looking toward tiny Gull Rock and its light station, 1 km to the west. Keweenaw Peninsula mainland on the horizon. (Photo by Michael R. Penskar.)

vascular plant species not previously known for Manitou Island, based on its abundance of bedrock shoreline formations known to be rich in such rare taxa, and as demonstrated in the floral diversity of adjacent mainland shores along the Keweenaw Peninsula. Additional objectives of 2005 surveys were to conduct surveys on nearby Gull Rock, to more intensively search the interior of Manitou Island for rare plants, and to more comprehensively classify and describe the vegetation types of Manitou Island[1].

Location and access

Manitou Island[2] is located in Lake Superior about 5 km east of the northern tip of Michigan's Keweenaw Peninsula (Figure 2). This 409 hectare island is about 5 km long and 1.6 km wide. According to Nichols and Nyholm (1995), Manitou is an Ojibwe word meaning "god" or "spirit." Manitou Island has a single dock that is located in a north shore cove about 1 km west of the Manitou Island Light Station at the island's eastern tip. The island's sole trail leads inland from the dock and then branches, one branch heading to the light station and the other west to the head of Fishermans Bay (T58N R26W Sec 21 NE ¼). Due to Lake Superior's low water levels in recent years, much of Manitou Island's rocky shoreline was easily accessible for hiking in 2005.

Gull Rock is an approximately 0.2 hectare island located about 1 km west of Manitou Island and ca. 4 km east of the northern tip of the Keweenaw Peninsula. Due to shallow reefs offshore and the lack of a dock, Gull Rock is most safely accessed by boat from nearby Manitou Island.

Ownership

About 230 hectares (56%) of Manitou Island is owned by the federal government, 130 hectares (32%) owned by the State of Michigan, and 37.4 hectares (9%) owned by the Keweenaw Land Trust (Manitou Island Light Station Preserve), who are currently restoring the light station. The remaining 12 hectares (3%) of the island is privately owned. Gull Rock is owned by the Gull Rock Lightkeepers, who are in the process of restoring the light station and outbuildings (Peter Annin, pers. comm.).

Geology, topography, and soils

The bedrock of Manitou Island, Gull Rock, and the Keweenaw Peninsula formed about a billion years ago during the Keweenawan Period of the Precambrian, a period of extensive surface volcanic activity (Reed and Daniels 1987; Dorr and Eschman 1984). During this period, approximately 400 basaltic

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[1] Selected areas of Manitou Island's bedrock shoreline were revisited as part of a state lands review (Cohen et al. 2008), during which some rare plant occurrences previously documented were observed and then subsequently updated; however, no known collections were obtained nor were any new taxa reported during this survey.

[2] There are several other Manitou Islands in the Great Lakes region, including a second Lake Superior Manitou Island located in Wisconsin's Apostle Islands National Lakeshore. Leelanau County's North and South Manitou Islands are located in northern Lake Michigan within the Sleeping Bear National Lakeshore.

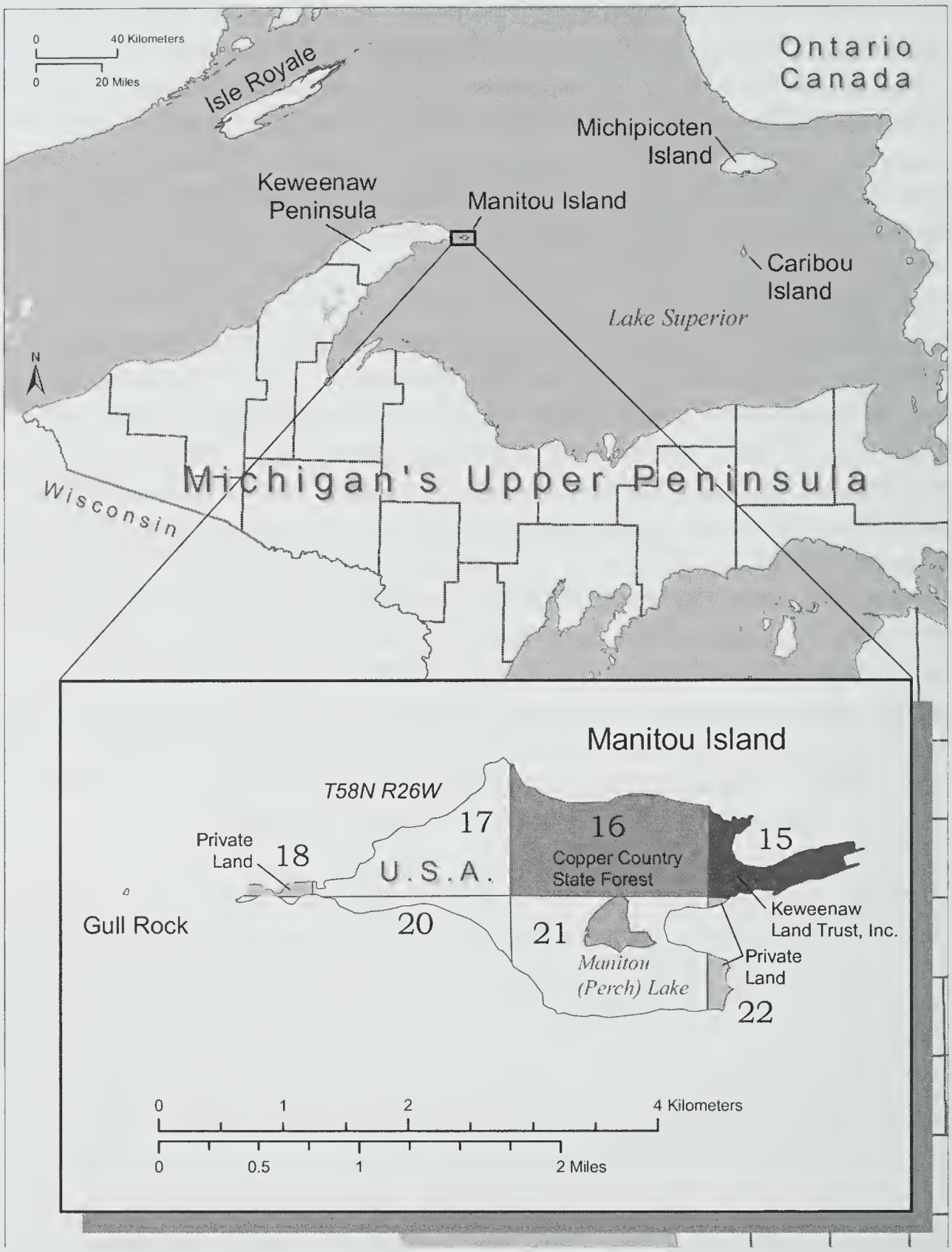

FIGURE 2. Location of Manitou Island and Gull Rock in Lake Superior off the tip of Michigan's Keweenaw Peninsula.

lava flows or "traps" were deposited, with 20 to 30 interbedded conglomerate and sandstone layers.

The weight of these 25 km-thick Keweenawan rock layers caused the formation of a structural sag known as the Lake Superior Syncline, a portion of which is now occupied by Lake Superior. As the earth's crust sagged, the thick horizontal layers of basaltic lava on the Keweenaw Peninsula dipped (bowed downward) as much as 40 degrees to the northwest into Lake Superior, while forming cliffs along the Keweenaw Peninsula's southeastern shore.

These thick Keweenawan basaltic lavas include about 10 km of Portage Lake Volcanics, upon which were deposited several kilometers of Copper Harbor Conglomerate (Reed and Daniels 1987). See Elmore (1984) for technical treatment of the Copper Harbor Conglomerate and Cornwall and White (1955) for a detailed geologic map of the Manitou Island quadrangle. The Copper Harbor Conglomerate along the northern shoreline of the Keweenaw Peninsula, and all of Manitou Island and Gull Rock, consists largely of conglomerate (strongly cemented pebbles and cobbles of volcanic origin), but also includes several lava flows collectively known as the Lake Shore Traps (Bornhorst and Rose 1994). Conglomerate makes up about 80% of Manitou Island's shoreline including much of the island's south shore (Bill Rose, pers. comm.). Although the Lake Shore Traps mostly occur on Manitou Island's north shore such as at the point directly north of the island's lone dock, they also are visible at the light station on the island's east end and inland as cliffs NW of Perch Lake (Bill Rose, pers. comm.).

Perch Lake may have been an embayment on Glacial Lake Nipissing, with the west side of Perch Lake perhaps representing Nipissing's shoreline of about 4000 years ago (Bill Rose, pers. comm.). Perch Lake would then have become isolated from Lake Superior as water levels receded to present-day Superior levels, exposing about a 150 m stretch of old cobble beach ridges that run from Perch Lake east to the head of Fishermans Bay.

Weathering, glacial erosion, and wave action have broken down Manitou Island's conglomerate, and the colorful red and purple pebbles now form four kilometers of steeply sloping cobble beaches on both the north and south shores of the island. The island's volcanic conglomerate shore is about 5 km in length and 6–18 m wide (Albert et al. 1997). The most extensive conglomerate exposures occur on Manitou Island's steeply-dipping north shore, while low cliffs 3 to 15 m high characterize much of the southern shoreline. Several large rocky cliff/knoll complexes, part of the Lake Shore Traps (Bill Rose, pers. comm.) and located about 250 m NW of Perch Lake's north shore, are in sharp contrast to the mostly level topography of the island's interior. The rocks that comprise Manitou Island are generally less than 6.5 m above Lake Superior (Thompson and Wells 1974).

The shallow, rocky soils that cover the interior of Manitou Island are formed from locally derived glacial drift. There are six numbered soil complexes mapped on the USDA and NRCS (2006) soils map for the island. Three complexes (numbered 10, 166B, and 196B) have minimal slopes with hydric and very poorly drained soils. The island's wetland community types thrive in drainageways and depressions where these complexes occur. The Arcadian-Nipissing-Rock outcrop complexes (51C with 1–12 percent slopes and 51E with 8–35 percent slopes) are widespread on Manitou Island. Boreal forest with its abundant blowdowns occurs here on shallow, well-drained soils, consisting of gravelly/cobbly fine sandy loam. The final complex (20E) mapped for Manitou Island consists of 90 to 100 percent rock outcrops with 2–35 percent slopes and very high surface runoff. This rock outcrop complex occurs as upland rocky knolls/ridges to lakeshore complexes and is the only type mapped for Gull Rock.

FIGURE 3. Balsam fir (*Abies balsamea*) blowdowns are extremely common in Manitou Island's interior due to shallow soils overlaying by bedrock. (Photo by Janet Marr.)

Vegetation

Much of Manitou Island's interior is vegetated by boreal forest consisting of balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), mountain maple (*Acer spicatum*), and showy mountain-ash (*Sorbus decora*). Owing to the island's very shallow soils underlain by bedrock, nearly impenetrable tangles of treefalls (blowdowns) are common (Figure 3), making travel in the island's interior slow-going and treacherous. Canada yew (*Taxus canadensis*) is one of the most common species in the understory, forming dense thickets over much of Manitou Island's interior, and thriving, at least in part, due to the absence of white-tail deer (Thompson and Wells 1974). In the wetter areas of the island's interior, there is a variety of wetland and aquatic plant communities including swamp forests, fens, shrub thickets, wet meadows, and marsh communities, all of which support a diversity of plant species. Several of these community types are associated with the island's only lake (Perch Lake). The island's shoreline communities of cobble beaches, cliffs, and rugged bedrock slopes (the latter being where most of the island's rare plant species occur) all support unique plant assemblages. Gull Rock's bedrock/cobble shoreline and adjacent light station grounds are home to ~13 plant species, about half of which are non-native species. Non-native plant species are mostly confined to disturbed areas such as in the vicinity of the light stations on both Manitou Island and Gull Rock, along the 1 km trail between Manitou Island's Light Station and the island's lone dock, and to a lesser extent, along Manitou Island's shoreline.

Human use and occupation

Fadner (2003) observed that an old copper mine pit on Manitou Island may have been mined by native peoples and later expanded by miners in the 19th century during the area's copper boom. An archaeological and historical sur-

FIGURE 4. Gull Rock Light Station perched on the tiny bedrock island of Gull Rock, located about 1 km west of Manitou Island. (Photo by Janet Marr.)

vey was conducted during the summer of 2006 (Deegan et al. 2007) including examination of the remains of structures associated with historic fishing activity on Manitou Island. Commercial fishermen, such as Red Cliff tribal member Cecil Peterson, continue to fish the waters around Manitou Island mostly during March and April (Paul Remali, pers. comm.).

In anticipation of increased shipping in Lake Superior upon completion of the Sault Ste. Marie locks in 1855, the first light station was built on the island's eastern tip in 1849, marking the treacherous underwater reefs along Manitou Island's shoreline. A second light station, replacing the original station, was completed in 1862. The Gull Rock Light Station opened in 1867 to make this small, often invisible, low bedrock island (Figure 4) more apparent to vessels heading toward emergency shelter in the Keweenaw Peninsula's south shore bay of Bete Grise. Today both lights are automatically operated and maintained by the Coast Guard.

It is unlikely much wood cutting was done on Manitou Island except for fuel wood cutting that occurred near the light station and the strip cut that was made about 50 years ago for the light station's phone line (Martin Nelson, pers. comm.).

According to Robert Ziel, Michigan DNR Fire Specialist (pers. comm.), there was a fire caused by lightning on 2 September 1998 in a 0.12 hectare area just west of Perch Lake[3]. Thin soils and conifer dominance, both prevalent on Manitou Island, are factors that make it more likely that fire will occur when there are lightning strikes. "The fire raging pretty heavy and very close to the

[3] Perch Lake has also been known as Lake Manitou (Fadner 2003) and was referred to as Manitou Lake in the 2006 plat book for Houghton and Keweenaw counties.

station" is an excerpt from the Manitou Island's lightkeeper's log from 25 August 1878 (cited in Fadner 2003) which suggests a fire occurred near the light station at the eastern tip of the island. Whether this was human- or lightning-caused is unknown. Joe Youngman (pers. comm.) did not recall seeing any fire scars or burnt snags in his many birding trips to Manitou Island, but points out that significant areas of *Betula papyrifera* exist on the island. This may indicate past fires, but could also be the result of extensive windthrow.

Botanical surveys of Manitou Island and Gull Rock prior to 1996

Several botanists have visited Manitou Island and compiled checklists of vascular plant species and in some cases obtained voucher specimens. Rare plant occurrences noted for the island, including observer/collector names, observation/collection dates, and occurrence numbers, are compiled in Table 1.

Richards (1952) visited Manitou Island on 17 June 1950 and collected 70 plant specimens, including five rare species, housed in various herbaria including the University of Michigan Herbarium (MICH) and the Billington Herbarium (BLH) at the Cranbrook Institute of Science. Thompson and Wells (1974) subsequently surveyed Manitou Island on 18 July 1972 and collected 133 voucher specimens that they contributed to BLH. Voice et al. (1982) visited Manitou Island on 12–14 June 1982 and surveyed the 268 hectares (662.5 acres) owned and managed at that time by the Bureau of Land Management (BLM). They documented locations of three rare plants including one state threatened species previously unknown for the island (Table 1). Voice et al. also visited Gull Rock on 12 June 1982 and reported nine total vascular plant species. Thompson and Wells (1974) and Voice et al. (1982) briefly described various upland, wetland, and aquatic community types present on Manitou Island.

METHODS

1996 Survey

A botanical and natural community inventory of the island, focusing primarily on shoreline and relatively accessible interior habitats, was conducted by Dennis A. Albert and Michael R. Penskar (Albert et al. 1997) on July 1, 1996. The survey was performed as part of a three-year statewide assessment and inventory of coastal bedrock communities (Albert et al. 1997). Prior to the one-day, intensive field survey, the Michigan Natural Features Inventory (MNFI) statewide database was examined to review the available data for previously identified rare plant and animal species and high quality community occurrences. The database review included examination of MNFI field forms, unpublished reports, and any other observations and resident file data for the island and adjacent areas with similar habitats. In addition to examination of the MNFI database, botanical field guides and the known literature of botanical and ecological exploration of the island were reviewed. Relevant geological publications were also consulted to review the origin and distribution of the bedrock formations of the region to help inform and direct field inventories.

Prior to initiating the field study, 1978 color-infrared photographs of the island were reviewed to prioritize field inventory, with surveys focused on coastal bedrock and the upper edges of cliffs that could be potentially accessed.

The field survey was conducted by accessing the island via canoe, which was launched from a transport boat in South Bay along the western end of the island, due to the inability to approach and land along the island's shallow, rocky shores with a larger, motor-powered craft. The island was then completely traversed by hiking all of the accessible shoreline areas, beginning in South

Bay (section 20) and working in clockwise fashion around the entire island. Black-and-white copies of the aerial photos were utilized while on the island, along with a 1:24,000 topographic map quadrangle, to systematically traverse the island and locate delineated survey areas. Nearshore habitats and representative interior areas were briefly examined, primarily to attempt to detect additional open patches of bedrock and also to characterize the vegetation and habitat of interior areas. When encountered, plant species known or suspected to comprise new records were vouchered, and the appropriate collection and field form data were recorded, in addition to annotating colony locations on the topographic map and taking representative photographs of both plants and plant habitats. Unknown taxa were collected as necessary for subsequent determination.

Following the field survey, specimens were pressed, determined, and then submitted to MICH by Michael R. Penskar for verification and accessioning. MNFI field data forms for high quality natural communities of the island, primarily coastal bedrock areas, were mapped and entered into the MNFI statewide database by Dennis A. Albert. The rare plant records identified were similarly processed by Michael R. Penskar, including the mapping of taxa new to the island as well as including updated status and distribution information for known rare species occurrences.

2005 Survey

Prior to the 2005 field season, various tasks were performed by Janet Marr in preparation for plant surveys on Manitou Island and Gull Rock. Pertinent literature was reviewed, knowledgeable individuals were consulted to obtain information about Manitou Island's plants and communities, and aerial photographs were reviewed to prioritize survey areas especially in the island's interior. In addition, rare plant occurrence records were obtained from the Michigan Natural Features Inventory's statewide database, permission was requested from landowners to survey their property, and collecting permits were obtained where applicable. After developing a target list of rare plant species that potentially could be found on the island because of known suitable habitats, a species matrix was constructed showing optimal search times based on the phenologies of documented and potential rare species. Using the matrix as a guide, field inventories were conducted by Janet Marr over a period of 17 days (26–29 May, 2–7 July, 17–23 August) in which Manitou Island's bedrock and rocky shoreline, interior areas, and the island's sole inland lake were searched for rare plant species and high quality natural communities. Certain habitats, such as interior wetlands and bedrock shoreline known to be rich in rare plants, were systematically surveyed several times during the summer in order to identify as many vascular plant species as possible. For each rare species identified, voucher specimens were either collected or photographs were taken. Locations of natural communities, rare plants, and other taxa of interest were recorded using a Garmin GPS Map 76 global positioning unit (NAD 83). Thirteen plant communities were mapped, described, photographed, and classified to general community types. Plant surveys of Gull Rock were conducted on 29 May and 6 July. Upon completion of fieldwork, voucher specimens were submitted by Janet Marr to MICH for verification and accessioning and to the Michigan State University herbarium (MSC) for accessioning.

RESULTS

Nomenclature follows the published volumes of the Flora of North America (1993+) and then Voss (1972, 1985, 1996).

Rare plant species

The locations of eight rare plant species, comprised of six state threatened and two special concern species (Table 1), were identified and documented in 1996 by Dennis A. Albert and Michael R. Penskar (Albert et al. 1997). Five of the six state threatened species were previously unknown for Manitou Island.

The locations of 10 rare plant species, comprised of seven state threatened and three special concern species (Table 1), were observed and documented by Janet Marr in 2005 (Marr 2006). Although these 10 species were previously

TABLE 1. Rare plant species of Manitou Island, Keweenaw County, Michigan, with collector/observer names, collection/observation dates, and number of occurrences.

Scientific name	Common names	Status in MI*	Richards	Thompson & Wells	Voice, et al.	Penskar & Albert	Marr	Number of occurrences**
			17-Jun-50	18-Jul-72	12–14 Jun-82	1-Jul-96	26–29 May, 2–7 July, 17–23 Aug 2005	
Bistorta vivipara (Linnaeus) Delarbre = *Polygonum viviparum* Linnaeus	alpine bistort	T				X	X	3
Calamagrostis lacustris (Kearney) Nash	northern reedgrass	T					X	1
Carex media R. Brown ex Richardson	a sedge	T				X	X	2
Castilleja septentrionalis Lindley	pale Indian paintbrush	T	X	X	X	X	X	2
Draba arabisans Michaux	rock whitlow-grass	SC	X			X	X	2
Dryopteris filix-mas (Linnaeus) Schott	male fern	SC	X				X	2
Huperzia selago (Linnaeus) Bernhardi ex Schrank & Martius	fir club-moss	SC					X	1

Luzula parviflora (Ehrhart) Desvaux	small-flowered woodrush	T				X	X	2
? *Moehringia macrophylla* (Hooker) Fenzl = *Arenaria macrophylla* Hooker	big-leaf sandwort	T	X (dubious record)					1
Osmorhiza depauperata Philippi	sweet cicely	T	X					1
Packera indecora (Greene) Á. Löve & D. Löve = *Senecio indecorus* Greene	rayless mountain ragwort	T			X		X	2
Poa alpina Linnaeus	alpine bluegrass	T				X	X	2
Trisetum spicatum (Linnaeus) K. Richter	downy oat-grass	SC	X		X	X	X	2
Viburnum edule (Michaux) Rafinesque-Schmaltz	squashberry	T				X	X	1
Viola epipsila Ledebour	northern marsh violet	E	X					1

*E=state endangered; T=state threatened; SC=special concern
**Individual occurrences are mapped as spatially discrete sites for species based upon natural heritage criteria.

known to occur on or near Manitou Island's bedrock shoreline, more extensive distributions for some species previously observed from just one or two localities on the island were noted and documented. Two additional rare plant species, the state threatened northern reedgrass (*Calamagrostis lacustris*) and state special concern fir club-moss (*Huperzia selago*), previously unknown for the island, were identified and documented by Janet Marr during exploration of the island's interior wetlands. No rare plants were observed during two visits to Gull Rock in 2005 (Marr 2006).

Three rare species, the state endangered *Viola epipsila*, and state threatened big-leaf sandwort (*Moehringia macrophylla*) and sweet-cicely (*Osmorhiza depauperata*), known only from historical collection records, were not relocated during surveys conducted by Albert et al. (1997) or Marr (2006).

Exotic plant species

Forty-nine exotic (non-native) plant species were identified on Manitou Island (Marr 2006). This total is a conservative number because some plants, like hawkweed (*Hieracium*) and bluegrass (*Poa*), could only be determined to genus and may represent one or more species. Most of the exotic plant species were found in disturbed sites. The greatest concentration of non-native plant species occurred in the vicinity of the Manitou Island Light Station and included orange hawkweed (*Hieracium aurantiacum*), *Hieracium* sp., bladder campion (*Silene vulgaris*), timothy (*Phleum pratense*), ox-eye daisy (*Leucanthemum vulgare*), common buttercup (*Ranunculus acris*), red sorrel (*Rumex acetosella*), fescue (*Festuca* sp.), and lilac (*Syringa vulgaris*). Exotic species occurring on the trail from the north cove dock to the light station included abundant *Hieracium* spp., *Phleum pratense*, and *Leucanthemum vulgare*. Non-native species such as *Hieracium* spp., mullein (*Verbascum thapsus*), butter-and-eggs (*Linaria vulgaris*), and bull thistle (*Cirsium vulgare*) were found on the island's shoreline. Another shoreline species, reed canary grass (*Phalaris arundinacea*), has native and non-native strains, the latter being particularly invasive. Specific locations and notes for selected occurrences of these non-native species are provided in Marr (2006).

Non-native species on Gull Rock included shepherd's-purse (*Capsella bursa-pastoris*), quack grass (*Elymus repens*), Canada bluegrass (*Poa compressa*), dandelion (*Taraxacum officinale*), and strawberry-weed (*Potentilla norvegica*), the latter of which has native and non-native forms.

Plant communities

Thirteen plant community types on Manitou Island and one type on Gull Rock were identified in the 2005 surveys (Marr 2006). Descriptions of these community types are presented after the rare species section below. Each description includes typical species found in that community type and references the detailed overview for these types as described in the MNFI statewide natural community classification (Kost et al. 2008) where applicable. Since not all of the plant community types encountered could be easily assigned to MNFI natural community types, we provide general characterizations with regard to dominants and plant community structure. The extreme climatic conditions

that characterize the island, including fog, ice, and strong winds, result in high levels of disturbance in both upland and wetland plant communities, and make classification of some community types difficult.

DISCUSSION

Rare species

Until 2005, the rare plant species identified on Manitou Island were known only on or in close proximity to the island's bedrock shoreline areas, often occurring in mossy crevices and similar types of pockets near the edge of the tree/shrub zone. *Calamagrostis lacustris* was discovered by Janet Marr in 2005, growing in a fen about 200 m inland from Lake Superior (Marr 2006). A second previously unknown species, *Huperzia selago*, occurred even farther inland, about 650 m from the Lake Superior shoreline, in a rich conifer (northern white-cedar [*Thuja occidentalis*]) swamp on the south edge of Perch Lake.

More extensive distributions of several species previously observed at just one or two localities on the island were noted by Marr (2006). For example, alpine bistort (*Bistorta vivipara*) was reported in 1996 in one area near the western tip of the island (Penskar 2005), whereas this rare shoreline species was found in several other locations along the north shore in 2005 surveys. Immature plants (in bud) of rayless mountain ragwort (*Packera indecora*) plants were reported by Voice et al. (1982) from one site on the north shore near the western end of Manitou Island. Owing to more extensive inventories conducted at the peak blooming period for this composite, Janet Marr was better enabled to identify and observe the status of this species on the island during her 2005 surveys. Additional locations for *Packera indecora* were observed on the north shore near the western end of the island, two locations on the south shore, sites along the south and north shores of Fisherman's Bay (sec 21 NE ¼), and in Square Bay (eastern point of section 15).

The majority of Manitou Island's rare species occur on its bedrock shoreline. Five of these rare shoreline plants (a sedge [*Carex media*], pale Indian paintbrush [*Castilleja septentrionalis*] [Figure 5], alpine bluegrass [*Poa alpina*], *Bistorta vivipara*, and downy oat-grass [*Trisetum spicatum*]), *Huperzia selago* from the island's interior, and several more common island species are arctic-alpine species that persisted after the retreat of the last Wisconsin era ice-sheet (Soper and Maycock 1963; Given and Soper 1981). These shoreline species are now considered to be disjunct from their main ranges to the north in Canada. Given and Soper (1981) speculate that a combination of unfavorable factors (i.e., dense, coniferous boreal forest and acidic granite-derived soils) between the Lake Superior region and Hudson Bay populations of these plants are responsible for the disjunction.

A combination of natural disturbance factors that affect Lake Superior's bedrock shoreline (such as abrasion from ice/snow in winter, cool/moist summers, and little to no soil) helps to prevent woody vegetation from encroaching along the shoreline, and low summer temperatures and fogs along the

FIGURE 5. Pale Indian paintbrush (*Castilleja septentrionalis*), a Michigan threatened and arctic-alpine plant species, that occurs on Manitou Island's bedrock shoreline. Nine of the 14 rare plants documented for Manitou occur on its bedrock shoreline, often near the tree/shrub zone. (Photo by Janet Marr.)

lakeshore create arctic-alpine-like climatic conditions that allow continued survival of these species.

Field surveys in 1996 (Albert et al. 1997) and 2005 (Marr 2006) were unsuccessful in searches for *Moehringia macrophylla.* A specimen (Richards # 3124) identified as this species could not be located in any herbarium (see Summary of rare plant collections below). Owing to this apparent lack of documentation, the report of *M. macrophylla* for Manitou Island must be considered dubious. Two additional species, *Osmorhiza depauperata* and *Viola epipsila,* both documented by herbarium specimens, were not relocated during 1996 and 2005 surveys. It is possible that these taxa may have once occupied very small, limited patches of suitable habitat now no longer existing, such as openings created through blowdowns or wildfires. Alternatively, given the lo-

gistical difficulty of conducting thorough inventories in the forested portions of island, it is plausible that small colonies of plants could escape detection despite repeated surveys. In any case, these species should still be sought in future inventories to determine their status.

Plant communities

BOREAL FOREST

Boreal forest in Michigan is dominated largely by conifer species characteristic of the boreal forest farther north in Canada. Coastal forests of the Great Lakes share these dominants, but also contain additional hardwood species and conifers with a broader distribution that may extend far to the south. Conifer dominance is especially strong on the islands and near the northern Great Lakes coast, probably due to cooler and moister conditions resulting from the surrounding Great Lakes. This conifer dominance is especially strong along Lake Superior, the coldest of the Great Lakes.

Much of Manitou Island is vegetated by boreal forest dominated by *Abies balsamea*, *Betula papyrifera*, *Acer spicatum*, and *Sorbus decora*. Abundant old man's beard lichens (*Usnea* spp.) hang from trees and blowdown areas are common. White spruce (*Picea glauca*) is a dominant tree species in some boreal forests, however, on Manitou Island it is uncommon, sometimes occurring as an emergent or super-canopy tree. Other small western Lake Superior islands, such as Isle Royale National Park's Passage Island (Judziewicz 1997) and some islands of the Apostle Islands National Lakeshore (Judziewicz and Koch 1993), have boreal forests similar to those occurring on Manitou Island.

VOLCANIC BEDROCK LAKESHORE

Penskar et al. (2002) point out that one of the island's most important plant communities is its "exemplary bedrock natural community." Rare plant species that occur along Manitou Island's bedrock shoreline are *Carex media*, *Castilleja septentrionalis*, rock whitlow-grass (*Draba arabisans*), small-flowered wood rush (*Luzula parviflora*), *Poa alpina*, *Bistorta vivipara*, *Packera indecora*, *Trisetum spicatum*, and squashberry (*Viburnum edule*). According to Albert et al. (1997), "one of the greatest concentrations of special plant species in the state is on the basic basaltic bedrock of the Keweenaw Peninsula, Manitou Island, and Isle Royale." Most of Manitou Island's rare species are associated with the bedrock known as Copper Harbor Conglomerate (CHC) (Albert et al. 1997). Some occurrences of *Bistorta vivipara* and at least one occurrence of *Carex media* occur on the smooth basaltic lava that is included within areas of the shoreline mapped as CHC. Albert et al. (1997) observed that plant diversity is greater on the vesicular lavas and the volcanic conglomerate portions of CHC rocks, with their cracks and small concavities that provide colonization habitat, in contrast to the lower diversity on smooth, massive basaltic rocks with few or no vesicles and thus little substrate for plant establishment.

Vegetation is lacking or sparse near the water line of Lake Superior due to the effects of wave and ice action. Most of the rare plant occurrences on the is-

land's bedrock shoreline occur high up on the steeply sloping volcanic rock, at or near the tree/shrub line in often-mossy cracks and crevices.

Common species of Manitou Island's bedrock shoreline include harebell (*Campanula rotundifolia*), a goldenrod (*Solidago simplex*), northern bog violet (*Viola nephrophylla*), wormwood (*Artemisia campestris*), and wild strawberry (*Fragaria virginiana*). Characteristic tree species bordering the island's shoreline consist of *Abies balsamea*, *Betula papyrifera*, *Thuja occidentalis*, *Acer spicatum*, and *Sorbus* sp. (Thompson and Wells 1974).

Although cobble beach and low lakeshore cliffs (~3 m high) are present on Gull Rock, most of the vegetation occurs on this tiny island's bedrock lakeshore and near the light station. Plant species include yarrow (*Achillea millefolium*), showy mountain-ash, chokecherry (*Prunus virginiana*), and red-berried elder (*Sambucus racemosa*). Non-native species of Gull Rock are listed above in the Results section.

Reschke (1985) provides a detailed overview and description of the vegetation of the conglomerate rock shoreline of the nearby Keweenaw Peninsula, including non-native species. Reschke found that moss and lichen diversity and coverage were higher than vascular-plant diversity and cover along the volcanic rock shoreline.

COBBLE SHORE (VOLCANIC COBBLE SHORE)

Manitou Island's Lake Superior shoreline is comprised of about 4 km of cobble beach (Dennis A. Albert, pers. comm.). Species growing at the upper margin of cobble beaches include *Abies balsamea*, *Betula papyrifera*, *Sorbus decora*, *Acer spicatum*, red-osier dogwood (*Cornus stolonifera*), buffalo-berry (*Shepherdia canadensis*), thimbleberry (*Rubus parviflorus*), *Taxus canadensis*, and the rare species, *Viburnum edule* (Figure 6). Vegetation is sparse on the cobble beach between the tree/shrub line and Lake Superior and includes such species as *Fragaria virginiana*, ninebark (*Physocarpus opulifolius*), and beach pea (*Lathyrus japonicus*).

Species growing on old cobble beach ridges in the 150 m stretch from Perch Lake east to the cobble beach at the head of Fishermans Bay include cherry (*Prunus* sp.), *Sambucus racemosa*, and touch-me-not (*Impatiens capensis*).

VOLCANIC LAKESHORE CLIFF

There are about 3 km of 3–15 m high bedrock cliffs lining Manitou Island's shoreline (Albert et al. 1997). The most impressive are the volcanic conglomerate lakeshore cliffs located near the eastern end of the island along the north shore of Fishermans Bay. Two rare species (*Trisetum spicatum* and *Draba arabisans*) occur on or near the cliff tops in this area. The cliff faces, pounded by lake waves and very difficult to access, could potentially harbor additional rare species.

INLAND CLIFF

Two inland rocky knolls/cliffs are located in one of the island's many blowdown areas (sec 16 SE ¼ SW ¼). Species here include *Abies balsamea*, *Betula papyrifera*, *Sorbus* sp., *Carex deflexa*, Canada mayflower (*Maianthemum*

FIGURE 6. All known rare plant species on Manitou Island are herbaceous with the exception of squashberry (*Viburnum edule*), a Michigan threatened shrub in the honeysuckle family (Caprifoliaceae). (Photo by Michael R. Penskar.)

canadense), tall corydalis (*Corydalis sempervirens*), bunchberry (*Cornus canadensis*), twinflower (*Linnaea borealis*), wild sarsaparilla (*Aralia nudicaulis*), and common polypody (*Polypodium virginianum*). An unusual small "boulder field" of large rocks occurs in a blowdown area of *Abies balsamea*, *Taxus canadensis*, and *Sorbus* sp. (sec 16 near center of SE ¼). *Maianthemum canadense*, *Carex deflexa,* and a moss (*Pleurozium schreberi*) are growing on the boulder tops.

SAND AND GRAVEL BEACH

Manitou Island's only sand beach, located on the island's south shore (sec 20 NE ¼), is broken by areas of cobbles. No species were observed growing on the open beach during the 2005 field survey. Evidently due to the instability of the sand beach, few species can establish and persist.

NORTHERN SHRUB THICKET

This wetland shrub community type, dominated by tag alder (*Alnus incana* ssp. *rugosa*), is common on Manitou Island. Typical species in alder thickets include *Cornus stolonifera*, skunk-cabbage (*Symplocarpus foetidus*), *Linnaea borealis*, marsh-marigold (*Caltha palustris*), northern blue flag (*Iris versicolor*), goldthread (*Coptis trifolia*), a club-moss (*Lycopodium annotinum*), and *Sphagnum* spp. In addition to the common species listed above, several orchid taxa were observed, including bracted orchid (*Coeloglossum viride*), tall white bog orchid (*Platanthera dilatata*), and moccasin flower (*Cypripedium acaule*). A probable club-moss hybrid, *Huperzia* ×*buttersii* (*H. selago* × *H. lucidula*) occurs in an alder thicket in the eastern quarter of the island (sec 15 SW ¼ SW ¼).

POOR FEN

This wetland community, located 200 m inland from Lake Superior (sec 15 SW ¼ SW ¼), is characterized by hummock-hollow microtopography, *Sphagnum* mosses, ericaceous shrubs (leatherleaf [*Chamaedaphne calyculata*], bog-rosemary [*Andromeda glaucophylla*], and Labrador-tea [*Ledum groenlandicum*]), and scattered stunted tree species (tamarack [*Larix laricina*], black spruce [*Picea mariana*], *Thuja occidentalis*, and *Abies balsamea*). Other species in this species-rich community include the state threatened *Calamagrostis lacustris* in addition to pitcher-plant (*Sarracenia purpurea*), false asphodel (*Triantha glutinosa*), northern bog goldenrod (*Solidago uliginosa*), small cranberry (*Vaccinium oxycoccos*), *Carex lasiocarpa, C. exilis*, bulrushes (*Trichophorum cespitosum* and *T. alpinum*), blue-joint (*Calamagrostis canadensis*), and many orchid species (grass-pink [*Calopogon tuberosus*], yellow lady-slipper [*Cypripedium parviflorum*], showy lady-slipper [*C. reginae*], *Platanthera dilatata*, and rose pogonia [*Pogonia ophioglossoides*]).

POOR CONIFER SWAMP

There are at least four poor conifer swamps dominated by *Picea mariana* and *Ledum groenlandicum* on Manitou Island (three in sec 16 S ½; a fourth just west of the SW corner of Perch Lake [sec 21 NE ¼ NW ¼]). Species include young *Larix laricina* trees, *Chamaedaphne calyculata,* bog-laurel (*Kalmia polifolia*), creeping-snowberry (*Gaultheria hispidula*), rattlesnake-plantain (*Goodyera tesselata*), *Carex trisperma*, heartleaf twayblade (*Listera cordata*), *Sarracenia purpurea*, and the mosses *Sphagnum* spp., *Ptilium crista-castrensis*, *Hylocomium splendens*, and *Pleurozium schreberi*. Openings created by blowdowns in this species-poor community often have dense ericaceous shrub growth.

An open-canopied poor conifer swamp, with dense shrub cover, occupies much of the Perch Lake shoreline, excepting the south shore. Species include scattered trees (*Abies balsamea*, *Larix laricina*, and *Thuja occidentalis*), *Alnus incana* ssp. *rugosa, Chamaedaphne calyculata*, *Ledum groenlandicum*, water horsetail (*Equisetum fluviatile*), bog buckbean (*Menyanthes trifoliata*), flat-topped white aster (*Doellingeria umbellata*), *Iris versicolor*, bulbil loosestrife (*Lysimachia terrestris*), three-leaved Solomon's-seal (*Maianthemum trifolium*), marsh potentilla (*Potentilla palustris*), *Gaultheria hispidula*, round-leaved sundew (*Drosera rotundifolia*), cinnamon fern (*Osmunda cinnamomea*), *Vaccinium oxycoccos*, cotton-grass (*Eriophorum* sp.), *Carex lasiocarpa*, *C. oligosperma*, and *Sphagnum* spp.

Perch Lake's aquatic plant and associated wetland community types

Perch Lake, Manitou Island's only inland lake, has a surface area of approximately 12 hectares and a depth of about 2 m near its center (Marr 2006). Beavers are currently active as evidenced by freshly beaver-chewed twigs and past activity includes an old beaver lodge on the south shore. A poor conifer swamp (described in the previous paragraph) and rich conifer swamp occur adjacent to Perch Lake. This rich conifer swamp community type and the emergent and submergent marsh communities that occur in the lake are described below.

FIGURE 7. Perch (Manitou) Lake, the only inland lake on Manitou Island, with a zone of emergent marsh around most of the perimeter of the lake. Emergent species include spike-rush (*Eleocharis palustris*), water-horsetail (*Equisetum fluviatile*), and a sedge (*Carex lasiocarpa*). (Photo by Janet Marr.)

EMERGENT MARSH

Emergent marsh, characterized by emergent herbaceous and grass-like plants occurs in shallow water along most of Perch Lake's shoreline (Figure 7). Species include spike-rush (*Eleocharis palustris*), *Equisetum fluviatile*, *Carex lasiocarpa*, three-way sedge (*Dulichium arundinaceum*), *Menyanthes trifoliata*, and swamp loosestrife (*Lysimachia thyrsiflora*). Although softstem bulrush (*Schoenoplectus tabernaemontani*) was common in 1972 according to Thompson and Wells (1974), it was not observed in 2005 (Marr 2006).

SUBMERGENT MARSH

Submergent marsh occurs in both shallow water amongst emergent marsh species and into deeper waters farther off shore in Perch Lake. It is comprised of both rooted and non-rooted submergent plants in addition to rooted floating-leaved plants. The most common submergent species are pipewort (*Eriocaulon aquaticum*) and water-milfoil (*Myriophyllum tenellum*), both species often forming dense mats in shallow water. Other submergent species are spiny-spored quillwort (*Isoetes echinospora*) and the non-rooted common bladderwort (*Utricularia vulgaris*). Underwater visibility was extremely poor on the 2005 survey date, and as a result, even common submergent species may have been missed.

Floating-leaved species, such as ribbon-leaf pondweed (*Potamogeton epihydrus*), variable pondweed (*P. gramineus*), pond-lily (*Nuphar variegata*), and

bur-reed (*Sparganium angustifolium*), occur in deeper water than emergent and other submergent marsh species. Although Thompson and Wells (1974) noted water-lily (*Nymphaea odorata*) in deeper waters of Perch Lake in 1972, this species was not observed in 2005 (Marr 2006).

RICH CONIFER SWAMP

Areas of rich conifer swamp dominated by northern white-cedar (some trees with diameters at breast height of ~66 cm) occur periodically along the south shoreline of Perch Lake. The Michigan special concern species, *Huperzia selago*, occurs in a cedar swamp near the SW corner of Perch Lake (sec 21 E ½ of NW ¼). Common species in cedar swamps along Perch Lake's south shore are *Abies balsamea*, *Betula papyrifera*, *Taxus canadensis, Ledum groenlandicum,* fly honeysuckle (*Lonicera canadensis*), *Coptis trifolia,* bluebead-lily (*Clintonia borealis*), *Linnaea borealis,* star-flower (*Trientalis borealis*), and *Sphagnum* spp.

NORTHERN WET MEADOW

An approximately 0.5 hectare opening with scattered tag alders and red-osier dogwoods is located about 18 m south of a north shore cobble beach (sec 17 NE ¼ SW ¼). Other species here include *Calamagrostis canadensis*, *Coptis trifolia*, *Caltha palustris*, *Viola* spp., *Carex intumescens*, spotted joe-pye-weed (*Eutrochium maculatum*), purple meadow-rue (*Thalictrum dasycarpum*), and royal fern (*Osmunda regalis*). This may be one of the numerous sedge-grass openings with scattered *Cornus stolonifera* described by Voice et al. (1982) as occurring on the north side of the island in Section 17.

Another wetland opening is located 1 km west of the eastern tip of Manitou Island and only about 50 m inland from Lake Superior (sec 15 W ½ SW ¼). The hydrologic regime of this unusual wetland community may be directly linked to Lake Superior and subject to seasonal fluctuations in the lake's water levels, as it is approximately at the same elevation as the lake. Species at the southern end of this approx. 0.5 hectare opening include *Impatiens capensis*, *Menyanthes trifoliata*, *Iris versicolor*, rattlesnake manna grass (*Glyceria canadensis*), *Carex leptalea*, and non-*Sphagnum* mosses. Two shrub species, *Chamaedaphne calyculata* and a willow (*Salix pedicellaris*), dominate elsewhere in the opening growing with *Calamagrostis canadensis*, *Doellingeria umbellata*, *Potentilla palustris*, *Iris versicolor, Lysimachia terrestris*, willow-herb (*Epilobium* sp.), bristly aster (*Symphyotrichum puniceum*), marsh bell-flower (*Campanula aparinoides*), *Carex utriculata*, and bulbiferous water-hemlock (*Cicuta bulbifera*). *Carex lasiocarpa* is the dominant species in the NE end which is probably the wettest part of the opening. This wetland is surrounded by a zone of tag alder with some *Sphagnum* present at the zone edge.

CONCLUSIONS

It is likely that additional botanical surveys of Manitou Island conducted throughout the growing season, especially in the island's still relatively unex-

plored interior, would result in documentation of rare species and plant communities previously unreported. In addition, new locations of known species and plant communities would likely be found.

Manitou Island has approximately 360 vascular plant species, about 14% of which are non-native species. The following are some comparisons between Manitou Island and other Lake Superior islands. Passage Island, a Lake Superior island off the NE tip of Isle Royale about ⅕ the size of Manitou Island, has a total of 271 species, 10% of which are non-native, and 34 (= 12%) that are "listed" rare species (Judziewicz 1997). Of Wisconsin's 23 Apostle Islands (including the mainland unit) in Lake Superior, only three islands (Madeline, Outer, and Stockton) have more vascular plant species than Keweenaw County's Manitou Island (Judziewicz and Koch 1993). These three Apostle islands are much larger than Manitou Island. Gull Rock, which in comparison, is only about 0.2 hectare in size, has ~13 vascular plant species, about 50% of which are non-native and none of which is rare.

Currently, the Federal Government, the State of Michigan, and the Keweenaw Land Trust are the three main landowners on Manitou Island. However, according to Kerry Wieber, MI DNR Forest Land Administrator (pers. comm.), the Federal Government is in the process of considering the conveyance of its holdings (230 hectares) to either the state of Michigan's Department of Natural Resources or to a local Native American tribe. This Great Lakes island, which is relatively isolated and has a history of minimal disturbance by humans and animals such as white-tail deer, deserves the highest degree of protection due to its rich diversity of breeding/migratory bird species, rare plant species, and other significant natural features.

SUMMARY OF RARE PLANT COLLECTIONS

MICHIGAN, KEWEENAW CO: MANITOU ISLAND:

Bistorta vivipara (Linnaeus) Delarbre, alpine bistort. Far west shore (sporadic along north shore), T58N R26W Sec. 18 SE ¼, Sec. 19 NE ¼, 1 July 1996, *Penskar 1363 with Albert* (MICH); north shore, crevices in bedrock shoreline, T58N R26W Sec. 18 SW ¼ SE ¼ SE ¼, 6 July 2005, *Marr 3329* (MICH).

Calamagrostis lacustris (Kearney) Nash, northern reedgrass. ~1 km west of east end of island, island's interior, shrub fen, T58N R26W Sec. 15 SW ¼ SW ¼, 21 August 2005, *Marr 3418* (MICH).

Carex media R. Brown ex Richardson, a sedge. North shore, T58N R26W Sec. 17, 1 July 1996, *Penskar 1365 with Albert* (MICH); north shore, ~1 km from island's east end, upper edge of bedrock shoreline, T58N R26W Sec. 15 NW ¼ SW ¼ , 4 July 2005, *Marr 3318* (MICH).

Castilleja septentrionalis Lindley, pale Indian paintbrush. Western end of the island, open rocky ground, 17 June 1950, *Richards 3083* (MICH); photographic record by Marr in 2005.

Draba arabisans Michaux, rock whitlow-grass. Western end of island, open rocky ground, 17 June 1950, *Richards 3084* (MICH, WUD, NY); bedrock shoreline of Copper Harbor conglomerate, T58N R26W Sec. 19 NE ¼ , 1 July 1996, *Penskar 1367 with Albert* (MICH); NW corner of Square Bay, cobble beach edge, T58N R26W Sec. 15 SW ¼ SE ¼ , 3 July 2005, *Marr 3296* (MICH); west end of island, bedrock crevices, T58N R26W Sec. 19 NW ¼ NE ¼, 6 July 2005, *Marr 3326* (MSC).

Dryopteris filix-mas (Linnaeus) Schott, male fern. East end of island, rock shore, 17 June 1950, *Richards 3122* (MICH). Fishermans Bay, north side of bay, upper edge of cobble beach, T58N R26W Sec. 15 S ½ SE ¼ SW ¼, 20 August 2005, *Marr 3399* (MSC); NW corner of Square Bay, boreal forest, T58N R26W Sec. 15 SW ¼ SE ¼ , 21 August 2005, *Marr 3404* (MICH).

Huperzia selago (Linnaeus) Bernhardi ex Schrank & Martius, fir club-moss. About 1 km west of east end of island, *Alnus incana* ssp. *rugosa* thicket, T58N R26W Sec. 15 SW¼ SW¼ SW¼, 27 May 2005, *Marr 3228* (MICH).

Probable *Huperzia* ×*buttersii* (Abbe) Kartesz & Gandhi (hybrid between *H. lucidula* and *H. selago*). South side of Perch Lake, cedar swamp, T58N R26W Sec. 21 SE¼ NW¼ , 28 May 2005, *Marr 3239* (MICH).

Luzula parviflora (Ehrhart) Desvaux, small-flowered wood rush. North shore, edge of bedrock shore and boreal forest, T58N R26W Sec. 17 SE ¼ , 1 July 1996, *Penskar 1364 with Albert* (MICH); north shore, bedrock shoreline, T58N R26W Sec. 17 SW ¼ SW ¼, 6 July 2005, *Marr 3331* (MICH).

Moehringia macrophylla (Hooker) Fenzl, big-leaf sandwort. Eastern end of island, on a steep bank along the shore, 17 June 1950, *Richards # 3124*, cited in Wells and Thompson (1974). Not relocated in 1972, 1982, 1996, or 2005. As this specimen was not located in MICH, MSC, BLH, MIN, and CAN, upon queries to curators of these herbaria, the report of this species for Manitou Island must be considered dubious due to the apparent lack of documentation.

Osmorhiza depauperata Philippi, sweet-cicely. East end of island, open woods, 17 June 1950, *Richards 3123* (MICH, BLH). Not relocated in 1972, 1982, 1996, or 2005.

Packera indecora (Greene) Á. Löve & D. Löve, rayless mountain ragwort. West end of island, 12 June 1982, Voice 82016 (MICH); south shore, bedrock shoreline, T58N R26W Sec. 21 NE¼ SE¼, 5 July 2005, *Marr 3321* (MICH); south shore, crevices in bedrock shoreline, T58N R26W Sec. 19 NE¼ NE¼ NE¼, 6 July 2005, *Marr 3325* (MICH); Fishermans Bay, N-facing bedrock slope, T58N R26W Sec. 21 E½ NE ¼, 20 August 2005, *Marr 3392* (MICH).

Poa alpina Linnaeus, alpine bluegrass. North shore, Copper Harbor conglomerate near tree line, T58N R26W Sec. 16 W ½ , 1 July 1996, *Penskar 1366 with Albert* (MICH); north shore, ~500 m west of east end of island, bedrock shoreline, T58N R26W Sec. 15 SE ¼ SW ¼, 3 July 2005, *Marr 3290* (MICH); Fishermans Bay, south shore of bay, bedrock shoreline, T58N R26W Sec. 21 E½ NE¼, 20 August 2005, *Marr 3393* (MSC).

Trisetum spicatum (Linnaeus) K. Richter, downy oat-grass. Near light station, grassy opening, T58N R26W near center of Sec.15 SE ¼ , 3 July 2005, *Marr 3299* (MSC); near light station, bedrock crevice, T58N R26W near center of Sec. 15 SE ¼ , 3 July 2005, *Marr 3301* (MSC).

Viburnum edule (Michaux) Rafinesque-Schmaltz, squashberry. West end of island, near south shore, T58N R26W Sec. 20 NW ¼, 1 July 1996, *Penskar 1362 with Albert* (MICH); south shore, cobble beach edge, T58N R26W Sec. 20 NW¼ NW¼, 5 July 2005, *Marr 3324* (MICH).

Viola epipsila Ledebour, northern marsh violet. East end of island, in rich moist woods, 17 June 1950, *Richards 3130* (BLH). Not relocated in 1972, 1982, 1996, or 2005.

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NOTEWORTHY COLLECTIONS

INDIANA

Brachyelytrum aristosum (Michx.) P. Beauv. ex Trel. (Poaceae). Northern shorthusk, bearded short-husk or long-awned wood grass.

Previous knowledge. Brachyelytrum aristosum is a perennial grass of moist forests, steep wooded slopes, roadsides and fairly disturbed forest edges (Fernald 1950; Saarela et al. 2003; Stephenson & Saarela 2007). Within North America, *B. aristosum* is known from Ontario to Newfoundland and south to Minnesota, Michigan and Pennsylvania; it has also been observed in northwest Indiana, northeast Ohio and south through the Appalachians to the intersection of Tennessee, North Carolina and Georgia (Saarela et al. 2003; Stephenson & Saarela 2007; USDA NRCS 2009). Prior to this collection, only two collections of *B. aristosum* were known from Indiana, both from Porter County. The first is a 1924 collection made at Keiser stored in the United States National Herbarium at the Smithsonian Institution (*Lyon s.n.*) (Saarela et al. 2003). The second is a 2007 collection made in sandy woods in Indiana Dunes State Park (*M. Homoya 07-07-07-78, with R. Hedge*) (Homoya, pers. comm.). Common synonyms for this species include *B. aristosum* var. *glabratum* Vasey and *B. erectum* var. *septentrionale* Babel (Saarela et al. 2003; Tropicos 2009).

A native of northern North America, *Brachyelytrum aristosum* is a species of concern in Tennessee, where it is listed as Special Concern (USDA NRCS 2009). It is considered Globally Secure (G4G5) and locally secure throughout much of its range, but is considered very rare and imperiled (S2) in Tennessee (Crabtree 2008).

Significance of the report. In many older botanical works, *Brachyelytrum aristosum* is not taxonomically split from *B. erectum* (Schreb.) P. Beauv. or is recognized only at the varietal level. Deam (1940) did not note *B. aristosum* in Indiana, and Swink & Wilhelm (1994) made no mention of *B. aristosum* in the Indiana counties of the Chicago Region, although they did note the presence of specimens intermediate between *B. erectum* and *B. aristosum* in adjacent Berrien County, Michigan (Stephenson 1971). Saarela et al. (2003) provided evidence that *B. aristosum* and *B. erectum* are distinct species. Few collections of *B. aristosum* from Indiana exist, although this typically northern species is known to occur in states to the southeast of Indiana. This collection represents a new record for LaPorte County, Indiana, and raises interest as to the full geographical range of the species within the state. Populations of *B. aristosum* are being monitored and tracked by the Indiana Department of Natural Resources, and if warranted, the species will be added to the Indiana list of endangered, threatened and rare plants (Homoya, pers. comm.).

Diagnostic characters. In terms of gross morphology, *Brachyelytrum aristosum* looks similar to *B. erectum*. However, the lemmas of *B. aristosum* are

scabrous with hairs up to 0.2 mm long, whereas those of *B. erectum* are hispid with hairs 0.2 to 0.9 mm long (Saarela et al. 2003; Stephenson & Saarela 2007). All veins of the lemmas of *B. aristosum* are of equal proportions; the mid-veins of the lemmas of *B. erectum* are more prominent than the lateral veins (Saarela et al. 2003; Stephenson & Saarela 2007). In addition, the anthers of *B. aristosum* are 2 to 3.5 mm long, whereas those of *B. erectum* are 3.5 to 6 mm long (Saarela et al. 2003; Stephenson & Saarela 2007).

Specimen citations. LAPORTE CO.: Sebert County Park, 6 miles northeast of Michigan City, Indiana, on the south side of CR 925 N, ca. 0.6 mile west of CR 300 W. Uncommon in upland forest in southeastern portion of site. Associated species: *Acer rubrum*, *Actaea pachypoda*, *Arisaema triphyllum*, *Hamamelis virginiana*, *Lindera benzoin*, *Polygonatum pubescens*, *Prunus serotina*, *Sassafras albidum*, *Viburnum acerifolium*, *Vitis riparia*, 13 July 2008, *SAN 487* (MOR). Same location, uncommon in mesophytic forest in southern portion of site. Associated species: *Acer rubrum*, *Arisaema triphyllum*, *Carex* sp., *Carpinus caroliniana* var. *virginiana*, *Circaea lutetiana* var. *canadensis*, *Lindera benzoin*, *Liriodendron tulipifera*, *Parthenocissus quinquefolia*, *Prenanthes* sp., *Quercus rubra*, *Smilacina racemosa, Solidago rugosa*, 26 July 2008, *SAN 522* (MOR). Identifications verified by M. Homoya, Indiana Department of Natural Resources—Division of Nature Preserves.

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INDIANA

Myosotis arvensis (L.) Hill (Boraginaceae). Field forget-me-not, field scorpion-grass or common forget-me-not.

Previous knowledge. Myosotis arvensis is an annual or biennial herb native to Eurasia that is weedy in waste places, clearings and fields, shores, lawns,

old gardens and along wooded trails and roadsides, often in sandy soil (Deam 1940; Fernald 1950; Gleason & Cronquist 1991; Swink & Wilhelm 1994; Voss 1996). Within North America, *M. arvensis* occurs throughout the southern half of Canada and much of the northern half of the United States southeast to Tennessee and South Carolina, with the exception of North Dakota, South Dakota and Nebraska (USDA NRCS 2009). Prior to this collection, only three Indiana records of *M. arvensis* have been recorded. Deam (1940) noted that it was reported in 1892 by Benedict and Elrod on sandy ridges and in sandy fields in Cass County, but he excluded it from the flora because it had not been reported since that time. Thomas et al. (2005) reported it from Harrison County along the Ohio River based on a 2003 collection (*W.E. Thomas 953* [JEF]). A third collection was made in 2002 from Posey County by Allison Cusick (*Cusick 36080* [MO]) (Yatskievych, pers. comm.).

Significance of the report. Although *Myosotis arvensis* is known from Indiana and all surrounding states, this collection represents one of only three known extant locations for this species in the state. *Myosotis arvensis* does not show potential to become invasive, but this collection adds to the existing knowledge of the natural history of the species and raises questions about the origin and introduction of the species at this site.

Diagnostic characters. Many species in the genus *Myosotis* can look similar. *Myosotis arvensis* is separated from *M. scorpioides* L. and *M. laxa* Lehm. in having calyx hairs that are loose or spreading and hooked or gland tipped as opposed to straight, appressed and eglandular (Fernald 1950). *Myosotis arvensis* has nearly regular calyces and usually blue corollas, whereas *M. verna* Nutt. and *M. macrosperma* Engelm. have unequally cleft, 2-lipped calyces and small, white corollas (Fernald 1950). The pedicels of *M. arvensis* are as long as or longer than the calyces; in *M. stricta* Link ex Rohm. & Schult. and *M. discolor* Pers. they are shorter than the calyces at maturity (Fernald 1950). In *M. arvensis* the limb of the corolla is 1.5 to 4 mm broad and spreading-ascending; *M. sylvatica* Ehrh., the species with which *M. arvensis* can most easily be confused, has corolla limbs 5 to 8 mm broad and flat (Fernald 1950). Swink & Wilhelm (1994) state that the pedicels of *M. arvensis* are subequal to exceeding the calyces, whereas those of *M. sylvatica* are shorter than the calyces. Voss (1996) notes that distinguishing between these two species using abundance of hairs, nutlet size, and calyx characters is difficult using pressed material.

Specimen citation. ST. JOSEPH CO.: St. Patrick's County Park, 17 May 2008, *SAN 247, collected with D. Marr, V. Riemenschneider and A. Schnabel* (MOR).

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MICHIGAN

Cardamine impatiens L. (Brassicaceae). Narrowleaf bittercress or touch-me-not bitter-cress.

Previous knowledge. Cardamine impatiens, an annual or biennial herb native to Eurasia, occurs in eastern North America in wet and mesic woods, along rivers and streams, in thicket margins and in shaded grasslands and wet meadows, often on calcareous substrates (Fernald 1950; Voss 1985; Glenn & Barringer 2004). It has also been observed along roadsides, footpaths and in lawns (Glenn & Barringer 2004). *Cardamine impatiens* is invasive in North America, where it occurs in the Canadian provinces of Ontario and New Brunswick and throughout the northeastern United States (with the exceptions of Maryland and Rhode Island) south to North Carolina and west to Kentucky and Michigan (USDA NRCS 2009).

Cardamine impatiens is considered a noxious weed and is banned from introduction into Connecticut and Massachusetts (USDA NRCS 2009).

Significance of the report. Before this collection, the known distribution of *Cardamine impatiens* in Michigan was limited to the vicinity of Ann Arbor in Washtenaw County (Voss 1985; USDA NRCS 2009) and Oakland County (Reznicek, pers. comm.), more than 150 miles from Berrien County. The location of this collection is just 5 miles north of the Indiana-Michigan state line; *C. impatiens* is currently known in Indiana only from Clark County, along the Ohio River (*W.E. Thomas 2742* [JEF]) (Thomas, pers. comm.). Voss (1985) noted that this species doubtless would become more widespread. Given its invasive potential in the Great Lakes states, it is important to track the continued spread of *C. impatiens* and to make natural resource managers aware of its presence.

Diagnostic characters. Cardamine impatiens is distinctly different from related species (Figure 1). It is most similar to *C. flexuosa* With., *C. hirsuta* L., *C. parviflora* L., *C. pensylvanica* Muhl. ex Willd. and *C. pratensis* L., all of which have compound or highly dissected leaves. *Cardamine impatiens* can be distinguished from *C. pratensis* by length of petals (absent to 2.5 mm long in *C. impatiens*, 8 to 15 mm long in *C. pratensis*) (Fernald 1950). *Cardamine flexuosa*, *C. hirsuta*, *C. pensylvanica* and *C. parviflora* all lack the sagittate-auriculate leaf bases present in *C. impatiens*, and the leaflets of these four species are mostly blunt (as opposed to often acuminate in *C. impatiens*) (Fernald 1950).

Specimen citations. BERRIEN CO.: Life Action Ministries Woods, just west of Niles-Buchanan Road and US-31, 41°49′N, 86°19′W. Common in

FIGURE 1. *Cardamine impatiens,* Berrien County, Michigan. Photo by Scott Namestnik.

walking path through somewhat degraded mesic woods leading towards St. Joseph River; also in woods adjacent to trail. Associated species: *Acer saccharum*, *Asplenium platyneuron*, *Carex cephalophora*, *Carex grisea*, *Carex rosea*, *Carex sparganioides*, *Carex swanii*, *Carya cordiformis*, *Circaea lutetiana* var. *canadensis*, *Cryptotaenia canadensis, Erigeron annuus*, *Festuca elatior*, *Fragaria virginiana*, *Fraxinus pennsylvanica* var. *subintegerrima*, *Geum canadense*, *Juncus tenuis*, *Liriodendron tulipifera*, *Lonicera maackii*, *Lonicera* sp., *Panicum* sp., *Parthenocissus quinquefolia*, *Phryma leptostachya*, *Poa compressa*, *Prunus serotina*, *Ranunculus recurvatus*, *Rosa multiflora*, *Taraxacum officinale*, *Trifolium repens*, *Veronica officinalis*, *Viola sororia*, *Viola striata*, 7 June 2008, *SAN 305* (MO), *SAN 306* (MICH), *SAN 308* (MOR), *SAN 309* (ND).

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WISCONSIN

Canadanthus modestus (Lindl.) G.L. Nesom (Asteraceae). Giant mountain aster, great northern aster, great northern bog aster, great western bog aster, northwestern sticky aster or Canada-aster.

Previous knowledge. Canadanthus modestus, a perennial herb of wet areas in cold climates, is most commonly found in moist woodlands, alder thickets, open fields, cedar swamps, montane forests and boreal forests, as well as along streams, on lake shores and near bogs (Fernald 1950; Semple & Heard 1987; Gleason & Cronquist 1991; Voss 1996; Brouillet 2006). *Canadanthus modestus* ranges from Alaska to Oregon and east across most of the northern tier of the contiguous United States to the Great Lakes and much of Canada to New Brunswick (Brouillet 2006; NatureServe 2008; USDA NRCS 2008). Prior to this newly reported population, *C. modestus* was known to occur in Alaska, Washington, Oregon, Idaho, Montana, Minnesota, North Dakota and Michigan, and the Canadian provinces of Yukon, British Columbia, Alberta, Saskatchewan, Manitoba, Quebec and New Brunswick (Brouillet 2006; NatureServe 2008; USDA NRCS 2008). A common synonym for this species is *Aster modestus* Lindl. (Brouillet 2006).

Canadanthus modestus is a species of concern in Michigan, where it is listed as Threatened (USDA NRCS 2008). Although considered Globally Secure (G5), it is considered Vulnerable (S3) in Yukon, Imperiled (S2) in Saskatchewan and Manitoba and Critically Imperiled (S1) in Quebec, New Brunswick and Michigan (NatureServe 2008).

Significance of the report. A search of Wisconsin herbaria yielded two records from the state purporting to be *Canadanthus modestus*, but both turned out to have been misidentified, making this collection the first of this species from Wisconsin. This discovery fills a gap in the North American range of *C. modestus*, as it is known from all surrounding states and provinces bordering Lake Superior. This collection also adds further understanding to the natural history and habitat requirements of *C. modestus*. Now that *C. modestus* has been documented in Wisconsin, it can be added to the Wisconsin Natural Heritage Working List as a species of concern, and its populations can be monitored and tracked by the Wisconsin Department of Natural Resources.

Diagnostic characters. Canadanthus modestus is described as having slightly to strongly auriculate-clasping leaves (the lower brown and deciduous at anthesis), densely spreading pubescent and stipitate-glandular peduncles, densely stipitate-glandular phyllaries, pale to dark purple or rose ray florets, whitish to pale yellow disc florets and obconic-fusiform, compressed, dark-nerved, pubescent and eglandular cypselae (Brouillet 2006; Gleason & Cronquist 1991; Semple & Heard 1987) (Figure 2). It appears similar to *Symphyotrichum puniceum* (L.) A. Löve & D. Löve var. *puniceum*, *S. novae-angliae* G. L. Nesom, and *S. oblongifolium* (Nutt.) G. L. Nesom. *Symphyotrichum puniceum* var. *puniceum* is eglandular throughout (Gleason & Cronquist 1991). *Symphyotrichum novae-angliae*, to which *C. modestus* is probably most simi-

FIGURE 2. *Canadanthus modestus*, Douglas County, Wisconsin. Photo by Scott Namestnik.

lar morphologically, has leaves that are usually more strongly clasping the stem than those of *C. modestus* and also has more ray flowers per head (45–100 versus 20–65) (Gleason & Cronquist 1991; Brouillet 2006). *Symphyotrichum oblongifolium* has smaller flower heads and involucres (5–8 mm versus 7–11 mm) and thicker leaves and phyllaries than *C. modestus*. In addition, the phyllaries of *S. oblongifolium* are chartaceous at the base, while those of *C. modestus* are herbaceous throughout (Gleason & Cronquist 1991).

Specimen citation. DOUGLAS CO.: ATC Mitigation Site, 46°39′10.08″N, 92°7′49.69″W. Rare in moist woods of quaking aspen, in partial shade and clay soil. Five small groups of plants observed, with stems arising singly from base of plant. Flowering. Deer browsing of some plants noted. Associated species: *Alnus rugosa*, *Athyrium filix-femina*, *Calamagrostis canadensis*, *Cornus stolonifera*, *Dryopteris cristata*, *Epilobium coloratum*, *Equisetum sylvaticum*, *Galium asprellum*, *Impatiens capensis*, *Mentha arvensis* var. *villosa*, *Polygonum sagittatum*, *Populus tremuloides*, *Ribes hirtellum*, *Rubus idaeus*

ssp. *strigosus*, *Rubus pubescens*, *Salix petiolaris*, *Salix pyrifolia*, *Stellaria longifolia*, 3 September 2008, *SAN 620, collected with P. Hlina, N. Kalkbrenner and G. Walton* (WIS). Identification verified by T. Cochrane (WIS).

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CONTENTS

Rare Plant Species and Plant Community Types of Manitou Island and Gull Rock, Keweenaw County, Michigan
Janet Keeney Marr, Michael R. Penskar, and Dennis A. Albert 97

Noteworthy Collections
Scott A. Namestnik 121

On the cover: *The highest conglomerate lakeshore cliffs on Manitou Island are located along the north shore of Fishermans Bay. Two Michigan special concern species, downy oat-grass* (Trisetum spicatum) *and rock whitlow-grass* (Draba arabisans), *occur on or near cliff tops in this area. Scale in photo is Bob Marr (height of 1.88 m). (Photo by Janet Marr.)*